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FINAL VOLUME
See Notice Inside

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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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Volume 33, Number 9, May 15, 1976

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Japan Atomic Energy Bureau–Atomic Energy Research Institute
Commissie Nucleaire Informatieverzorging (Netherlands)
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Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

NOTICE

The publication of *Nuclear Science Abstracts* is planned to be discontinued after Vol. 33, No. 12, dated June 30, 1976. *Atomindex*, published by the International Atomic Energy Agency and a product of the International Nuclear Information System (INIS), will provide essentially identical literature coverage, subject scope, abstracting and indexing with that of *NSA*. For all practical purposes the two journals are identical. The Energy Research and Development Administration, formerly the Atomic Energy Commission, has supported the concept and development of INIS for several years. At this time, it is quite apparent that the decentralized scanning, abstracting and indexing on a country-by-country basis is reliable and successful. Consequently, it is no longer necessary for the United States to bear the entire burden of publishing an abstract journal covering the world's nuclear literature. ERDA will continue to provide coverage of U. S. nuclear literature to INIS.

Atomindex is available on a subscription basis in the United States from UNIPUB, P. O. Box 433, Murray Hill Station, New York, New York 10016, for $150 per year including cumulative indexes. ($110 per year without cumulative indexes.) For others, *Atomindex* is available from the International Atomic Energy Agency, Publications Section, P. O. Box 590, A-1011, Vienna, Austria, at the same price.

ERDA's new journal, *ERDA Energy Research Abstracts (ERA)*, will contain abstracts and indexes to all literature of ERDA origin as well as nonnuclear energy information generated by foreign countries with which ERDA has agreements for cooperation. *ERA* is available to government agencies on the same basis as *NSA* and on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information.

The public may obtain *ERA* from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The annual subscription rate for the 12 regular issues including an annual cumulative index is $119 for domestic subscribers, and $148.75 for foreign subscribers. Individual issues will be priced at $7.40 domestic, and $9.25 foreign. Separate annual index cumulations will cost $30.50 domestic, and $38.15 foreign.

INDEXES TO *NSA*

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SOLDAN, D.W., Shipping container for a bottle of radioactive material, 32:20442
SOLDAT, J.K., Dosimetry of the radioactive noble gases, 32:19918 (BNWL-SA-4813)
SOLOMAKHA, D.A., Measurement of the 1.15-μm wavelength of a helium--neon laser, 32:19555

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

URANIUM ORES/GEOCHEMISTRY
Change of uranium concentration in plagioclase of various zones of microcline--albite--oligoclase pegmatites of Karelia, 32:19704
URANIUM ORES/LEACHING
Preparation of uranium compounds (Patent), 32:19329
URANIUM ORES/MINING
The uranium mining and its importance for the energy supply, 32:19701
URANIUM ORES/ORE PROCESSING
Supplies for the fuel cycle for Spanish nuclear power plants, 32:19702
URANIUM OXIDES
See also URANIUM DIOXIDE
URANIUM OXIDES U3O8

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

20457 (LA-5954) 100-MHz POWER AMPLIFIER DESIGN AND CONTROL FOR A HEAVY-ION ACCELERATOR, Lunsford, J. S.; Shipley, J. P.; Sutton, J. **(Los Alamos Scientific Lab., N. Mex. (USA)).** Jul 1975. 11p. Dep. NTIS $4.00.

is indexed as:

LOS ALAMOS SCIENTIFIC LAB., N.MEX. (USA)
100-MHz power amplifier design and control for a heavy-ion accelerator, 32:20457 (LA-5954)
Characterization of transuranic solid wastes from a plutonium processing facility, 32:19398 (LA-5993-MS)
Electrical breakdown and tracking characteristics of pulsed high voltages in cryogenic helium and nitrogen, 32:19495 (LA-UR-75-1032)
Engineering concepts for laser-fusion reactor applications, 32:19493 (LA-UR-75-736)
Evaluation of pre-impregnated resin-glass systems for insulating superconducting magnets, 32:19583 (LA-UR-75-1099)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

L-	**(Misc.)**	
9389	32:20494	See N-74-35219
LA-		
2429	32:20210	Dep. NTIS, $12.00
5931	32:21563	Dep. NTIS, $5.45
LA-tr-		
75-14	32:21506	Dep. NTIS, $7.75
75-26	32:19253	Dep. NTIS, $4.00
LA-UR-		
75-736	32:19493	Dep. NTIS, $4.00
75-791	32:20772	Dep. NTIS, $4.50
75-1331	32:19238	Dep. NTIS, $4.00
LBL-		
2874	32:19889	Dep. NTIS, $9.25
3633	32:21097	Dep. NTIS, $13.50
LFEN-	**(Portugal)**	
165-b	32:21507	INIS

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 19792, 20710, and 22693.

19643 DETERMINATION OF URANIUM AND PLUTONIUM IN NUCLEAR FUELS. Sorantin, H. Weinheim, Ger.; Verlag Chemie (1975). 285p.

Methods for the determination of U and Pu are reviewed. Comparison tables illustrate the effectiveness of individual methods in relation to the concentration range. Chapter titles are: objectives of fuel elements analysis; evaluation of analytical procedures; analysis of nonirradiated fuel elements; and analysis of irradiated fuel elements. (approximately 3000 references) (JGB)

Activation and Nuclear Reaction Procedures

Refer also to abstract 20328.

19644 (RISO-M-1814) WHY INTERFERENCE TESTS? Damsgaard, E.; Heydorn, K. (Danish Atomic Energy Commission, Risoe. Research Establishment). 6 Aug 1975. 11p. (CONF-750876-1). Dep. NTIS (US Sales Only) $3.50.

From 4th symposium on recent development in neutron activation analysis; Cambridge, United Kingdom of Great Britain and Northern Ireland (UK) (4 Aug 1975).

In neutron activation analysis, correction for interference from other elements is usually carried out in the data processing; this is, however, only feasible when the radionuclides in question have at least one significant peak that is interference-free. Interference between nuclides with only one major photopeak and with comparable half-lives is best resolved by applying corrections based on experimentally determined values. In an extension of the previous method for the determination of As, Mn, and Se to include Cu and Zn, interference from Cu in the determination of Zn is of this type. Furthermore, ^{64}Cu interferes not only with the ^{69m}Zn indicator used for determination of Zn in the separated sample, but also with the ^{65}Zn tracer added for chemical yield determination. Tests of the accuracy of the method were carried out by analysis of Standard Reference Materials 1571, Orchard Leaves, and 1577, Bovine Liver, from the National Bureau of Standards. For Orchard Leaves and for most biological materials, the interference from Cu was below the limit of detection for Zn; for Bovine Liver and other materials with unusual trace concentrations, correction was applied by means of an iterative procedure. Excellent agreement with certified values was finally obtained for both materials. (auth)

19645 PATHWAYS OF THIRTY-SEVEN TRACE ELEMENTS THROUGH COAL-FIRED POWER PLANT. Klein, D. H.; Andren, A. W.; Carter, J. A.; Emery, J. F.; Feldman, C.; Fulkerson, W.; Lyon, W. S.; Ogle, J. C.; Talmi, Y.; Van Hook, R. I.; Bolton, N. (Oak Ridge National Lab., TN). Environ. Sci. Technol.; 9: No. 10, 973-979(Oct 1975).

Coal, fly ash, slag, and combustion gases from a large cyclone-fed power plant 870 MW(e) were analyzed for a suite of elements. Mass balance calculations show that the sampling and analyses were generally adequate to describe the flows of these elements through the plant. Most Hg, some Se, and probably most Cl and Br were discharged to the atmosphere as gases. As, Cd, Cu, Ga, Mo, Pb, Sb, Se, and Zn were quite concentrated in fly ash compared to the slag, and were more concentrated in the ash discharged through the stack than in that collected by the precipitator. Al, Ba, Ca, Ce, Co, Eu, Fe, Hf, K, La, Mg, Mn, Rb, Sc, Si, Sm, Sr, Ta, Th, and Ti show little preferential partitioning between the slag and the collected or discharged fly ash. Cr, Sc, Na, Ni, U, and V exhibit behavior intermediate between the latter two groups. (auth)

19646 AN ACCURATE AND SENSITIVE METHOD FOR THE DETERMINATION OF THE DEPTH DISTRIBUTION OF LIGHT ELEMENTS IN HEAVY MATERIALS. L'Ecuyer, J.; Brassard, C.; Cardinal, C.; Chabbal, J.; Deschênes, L.; Labrie, J.P. (Laboratoire de Physique Nucléaire, Université de Montréal, Montréal, Canada); Terreault, B.; Martel, J.G.; St.-Jacques, R. J. Appl. Phys. 47: No. 1, 381-382 (Jan 1976).

A method for the determination of the depth distribution of light elements in heavy materials is described. It involves the detection of light elements recoiling under the bombardment by a ^{35}Cl beam. A resolution of 300 Å was achieved for the lithium present in a thin sample. The measures were done with layers of 10^{16} atoms/cm^2 and it is estimated that quantities as small as 10^{14} atoms/cm^2 can be located without much difficulty. (auth)

19647 PATHWAYS OF THIRTY-SEVEN TRACE ELEMENTS THROUGH COAL-FIRED POWER PLANT. Klein, D. H.; Andren, A. W.; Carter, J. A.; Emery, J. F.; Feldman, C.; Fulkerson, W.; Lyon, W. S.; Ogle, J. C.; Talmi, Y.; Van Hook, R. I.; Bolton, N. (Oak Ridge National Lab., TN). Environ. Sci. Technol.; 9: No. 10, 973-978(Oct 1975).

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Chemical and Spectral Procedures

Refer also to abstracts 20426 and 20568.

19648 (HEDL-TMT-2(Vol.2)) ANALYTICAL CHEMISTRY LABORATORY MANUAL. Volume 2. Analytical Chemistry Methods for Mixed Uranium-Plutonium Oxide Fuel. Delvin, W. L. (ed.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1973. Contract E(45-1)-2170. 286p. AT.

This volume contains HEDL methods for the analysis of materials used to produce mixed oxide fuel for nuclear reactors; sintered pellets of mixed oxide and UO_2, Pu and U oxides, and nitrate solutions. Methods are included for the determination of composition, impurities, and physical characteristics. (DLC)

19649 (IS-3558(Vol.1)) BIBLIOGRAPHY OF MASS SPECTROSCOPY LITERATURE FOR 1972 COMPILED BY A COMPUTER METHOD. Volume I. Bibliography and Author Index. Capellen, J.; Svec, H. J.; Sage, C. R.; Sun, R. (comps.). (Ames Lab., Iowa

(USA)). Aug 1975. Contract W-7405-eng-82. 499p. Dep. NTIS $13.50.

This report covers the year 1972, and lists approximately 10,000 articles of interest to mass spectroscopists. This two-volume report consists of three sections. Vol. I contains bibliography and author index sections. The bibliography section lists the authors, the title, and the publication data for each article. The author index lists the authors' names and the reference numbers of their articles. (auth)

19650 (SAND-75-8680) RELATIVE SPUTTERING YIELDS AND QUANTITATIVE SURFACE ANALYSIS BY AUGER SPECTROSCOPY. West, L. A. (Sandia Labs., Livermore, Calif. (USA)). Dec 1975. Contract AT(29-1)-789. 30p. (CONF-751023-5). Dep. NTIS $4.00.

From 22nd national vacuum symposium; Philadelphia, Pennsylvania, USA (28 Oct 1975).

During the past few years, the qualitative analysis of surfaces by Auger electron spectroscopy has become an accepted analytical technique. With all analytical techniques, however, the ultimate goal is to obtain quantitative information. This paper presents data on the relative sputtering yield of several elements obtained by studying the surface composition of alloy systems (Cr-Pd, Ag-Pd, Cu-Pd, Mn-Ag-Pd and Nb-U) varying in composition from a few to roughly fifty atomic percent. The reported measurements were taken while sputtering after the alloy surface had reached a steady-state composition. Peak heights were referenced to in situ standards of the pure alloy components. Multiple determinations were carried out over a period of several weeks in order to check the reproducibility and to estimate the standard deviation in the data. This information was used to obtain uncertainty limits for the calculated sputtering yields. (auth)

19651 (UCRL-Trans-10759) TRACE ANALYSIS BY CONCENTRATION ON ION EXCHANGE PAPERS, AND X-RADIOISOTOPIC FLUORESCENCE. Robert, A.; Valles, R. Translated from Radiochem. Radioanal. Lett.; 15: No. 4-5, 279-289 (1973). 11p. Dep. NTIS $3.50.

The method of concentration on ion exchange resin-loaded paper is applied to the preparation of samples for x-ray radioactive fluorescence analysis. Examples are described for the elements Ca, Ba, Pb, U in aqeuous solution. Limits of detection for these elements and a practical method of preparation are about 10^{-1} ppM. (auth)

19652 SIMPLE QUANTITATIVE DETERMINATION OF CALCIUM, BARIUM, AND STRONTIUM, APPLIED TO THE DETERMINATION OF CALCIUM IN SODIUM CHLORIDE AND POTASSIUM CHLORIDE CRYSTALS. Berg, K. J.; Froehlich, F.; Siemroth, J. (Martin Luther Univ., Halle-Wittenberg, Ger.). Wiss. Z. Martin-Luther-Univ., Halle-Wittenberg, Mat.-Naturwiss. Reihe; 22: No. 2, 49-58(1973).

Ca, Ba and Sr can be determined to within ±5% at concentrations >1 μg per ml by titration with EDTA solution with use of fluorescein complexan as indicator and measuring the fluorescence under uv irradiation. The validity of the method was demonstrated by use of nominally pure sodium chloride and potassium chloride crystals, with and without addition of known small amounts of the Ca salt: the concentration of Ca in the crystals without additions were found to be 20 ppM and 5 ppM, respectively. (Anal. Abstr.)

19653 TENTATIVE METHOD FOR THE DETERMINATION OF ZIRCONIUM IN STEEL. Boniface, H. J.; Aitchison, C.; O'Leary, R. Br. Steel Corp., Open Rep.; vp(Mar 1975).

The method, intended for use with plain C-steels containing Zr 0.0005 to 0.20%, comprises cupferron separation and photometric determination of the Zr—catechol-violet complex. Application of the method to a standard steel demonstrated precision and reliability. (Metals Abstr.)

19654 DETERMINATION OF URANIUM IN NATURAL WATERS, SEDIMENTS, AND IN BIOLOGICAL MATERIALS. Hanusova, J.; Havlik, B. Cesk. Hyg.; 19: No. 5, 227-234(1974). (In Czech).

A description is given of a photometric method for determining uranium in samples of natural water, sediments, and biological material. The determination is based on the reaction of U(IV) (after reduction with zinc and ascorbic acid) with Arsenazo III. The blue-green complex formed is measured photometrically at 665 nm (red filter). With suitable cuvettes (width 5 cm), the lower sensitivity threshold is 1/μg of the absolute amount of uranium in the sample. The presence of Th and Zr affects the determination with a positive error that can be eliminated by adding oxalic acid as a masking agent. Since the determination is performed in a very acidic medium U(IV) can be determined selectively in the presence of Al, Ca, Ce, Cr(III), Mg, Mn(II), Mo(IV), Ni, Sn, V(V), Pb, W(VI), Zn, and Fe(III). The determination is influenced by Ti(IV) which causes low results, while Ti(III) decomposes the agent. (Czech. Biblio)

19655 X-RAY SPECTROMETRIC ANALYSIS OF PLUTONIUM–ZIRCONIUM ALLOYS. Walden, J. C.; Wallace, P. L.; Magana, J. W. (Univ. of California, Livermore). Appl. Spectrosc.; 29: No. 2, 175-178(1975).

An x-ray spectrometric method for analyzing binary plutonium-zirconium alloys containing 1 to 25 wt percent Zr has been developed. The alloys are analyzed as solutions in 8 M nitric acid. Yttrium is added as an internal standard. The techniques involved in handling and containing the radioactive solutions in conventional liquid cells are described in detail. No modifications to the x-ray spectrometer are required. Adaptations of this method have been used for the analysis of binary plutonium-gallium and plutonium-uranium alloys. (auth)

19656 APPLICATION OF GRAPHITE FURNACE ATOMIC ABSORPTION TO THE DETERMINATION OF IMPURITIES IN URANIUM OXIDES WITHOUT PRELIMINARY CHEMICAL SEPARATION. Bagliano, G.; Benischek, F.; Huber, I. At. Absorpt. Newsl.; 14: No. 3, 45-48(1975).

Graphite furnace atomic absorption was tested for the determination of V, Cr, Mn, Fe, Co and Mo present as impurities in uranium oxide samples without a preliminary separation. For V and Mo a quantitative determination was not possible, probably because the maximum available atomization temperature used was not high enough to decompose intermediate chemical compounds completely. The precision of the analysis and accuracy were quite satisfactory for the other elements. (Metals Abstr.)

Radiometric and Radiochemical Procedures

Refer also to abstracts 20281, 20288, 20290, 20779, 20900, 20907, and 22677.

19657 (RISO-M-1822) MULTI-ELEMENT ANALYSIS OF HUMAN LIVER AND PIG LIVER AND KIDNEY. Kemp, K.; Jensen, F. P.; Moeller, J. T.; Hansen, G. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1975. 10p. Dep. NTIS (US Sales Only) $3.50.

The earlier developed (Riso-M-1732) preparation technique for multi-element analysis of rat liver tissue by proton-induced x-ray emission spectroscopy (PIXE) was used on pig liver and kidney and on human liver. The detection limits and the reproducibility of samples from the same organ were the same as earlier. Only As and Ni showed great variations within the same organ. The investigation did not elucidate whether these variations were due to a really different distribution of these elements or to experimental errors. Unlike earlier investigations, the measurements showed relatively small variations within the same organ (5-10%) of the concentration of most elements in human liver. (auth)

19658 (SAND-75-8296) RELATION OF IRON, ALUMINUM, AND SILICON LAYER THICKNESSES TO THE ELECTRON MICROPROBE BEAM SIZE. Estill, W. B.; Smugeresky, J. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 23p. Dep. NTIS $3.50.

Nonconventional standards containing layers of known thicknesses of iron, aluminum, and silicon in a beryllium matrix were used to determine the effect of the size of a region enriched in these elements on the x-ray emission generated by an electron microprobe beam. These thicknesses were nominally 0.5, 1.0, 2.0, 5.0, and 10.0 mu m and represent regions with dimensions of the order of the effective spot size. By analyzing these layers, calibration curves were generated to allow corrections to be made to standard intensities used for quantitative analyses in this size regime. As a result, a procedure was developed to allow a more accurate quantitative analysis of regions as small as 0.5 mu m using characteristic x-ray emission. (auth)

19659 (UCRL-Trans-10983) ELECTROLYTIC FABRICATION OF CALIBRATION SOURCES IN ALPHA SPECTROMETRY. Irlweck, K.; Sopantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Inst. fuer Strahlenschutz). Nov 1975. Translation of SGAE-2368. 23p. Dep. NTIS $3.50.

The most important electrolysis methods described in the literature for the preparation of calibration samples are compiled. Studies on the completeness of the electrolytic deposition of ^{239}Pu showed that quantitative deposition was obtained after 30 min. The preparation of U, Np, and Am samples by electrolytic

deposition was also reported. Results of calibration measurements using U solutions are shown graphically. It was concluded that the electrolysis method is suitable for the preparation of samples for alpha spectrometry studies. (JSR)

19660 AMERICAN NATIONAL STANDARD GUIDE TO CALIBRATING NONDESTRUCTIVE ASSAY SYSTEMS. ANSI N15.20-1975. New York; American National Standards Institute (1975). 31p.

This standard has application in NDA techniques for the measurement of nuclear materials by the observation of spontaneous or stimulated nuclear radiations. Limitations of such techniques are discussed. Acceptable procedures are presented for the general use of NDA methods, including calibration, error estimation, and measurement assurance. Recommended calibration, operating, and assurance methods represent guiding principles based on current NDA technology. The diversity of industry-wide nuclear materials measurement applications and instrumentation precludes discussion of specific measurement situations. As a result, compliance with practices recommended in the standard must be based on a thorough understanding of contributing variables and performance requirements of the specific measurement application. (WHK)

19661 BETA-INDUCED X RAYS FROM OXIDES ON METAL TRITIDE FILMS: A SIMPLE THEORETICAL MODEL. Haggmark, L.G. (Sandia Laboratories, Livermore, California 94550). J. Appl. Phys. 47: No. 1, 357-361 (Jan 1976).

A simple theoretical model has been developed to determine the intensity of the metal x rays emitted from metal tritides and also the intensity of the oxygen x rays from oxides that form on the surface of these tritides. This model includes the transport of the beta-decay electrons, the details of the x-ray production mechanisms, and the transport of the x rays out of the tritide films. It was found that for small surface oxide densities the ratio of the intensities of oxygen-to-metal x rays is a sensitive indication of the amount of surface oxide present. Reasonable comparisons were made with measured $O(K_\alpha)/Er(L_\alpha)$ intensity ratios from Er(D,T). (auth)

19662 DETERMINATIONS OF OXIDE THICKNESSES ON TRITIDED ERBIUM FILMS USING BETA-INDUCED X-RAY FLUORESCENCE. Muskat, R.G.; Bauer, W. (Sandia Laboratories, Livermore, California 94550). J. Appl. Phys. 47: No. 1, 353-356 (Jan 1976).

For a tritided erbium film, tritium-decay betas induce characteristic x-ray emission from the film, the Er_2O_3 oxide layer, and the substrate. Measurement of the beta-induced x-ray spectrum for x rays with energies between ~0.3 and 8 keV using a windowless Si(Li) detector permitted evaluation of the $O(K_\alpha)/Er(L_\alpha)$ intensity ratio. This ratio was correlated with the total oxygen surface density as determined using proton-induced x rays from the same films, and the results have beeen compared to a theoretical model by Haggmark. A strong dependence of the $O(K_\alpha)/Er(L_\alpha)$ ratio on Er_2O_3 areal density has been demonstrated for oxide thicknesses less than ~300 Å. (auth)

19663 SEQUENTIAL ANALYSIS OF ^{237}Np, ^{239}Pu, ^{241}Am, AND ^{244}Cm IN ENVIRONMENTAL MATRICES. Wessman, R. A.; Lee, K. D.; Curry, B. U.; Leventhal, L. (LFE Environmental Analysis Labs., Richmond). Trans. Am. Nucl. Soc.; 22: 99-100(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19664 TOTAL PLUTONIUM AND URANIUM DETERMINATION BY γ-RAY DENSITOMETRY. Canada, T. R.; Parker, J. L.; Reilly, T. D. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 140-141(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19665 REACTIVITY PERTURBATION ASSAY OF IRRADIATED FUEL RODS. Green, L. (Bettis Atomic Power Lab., West Mifflin, PA). Trans. Am. Nucl. Soc.; 22: 141-142(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19666 ANALYSIS OF LOW RADIOACTIVITY LEVEL ENVIRONMENTAL SAMPLES. Yule, H. P. (NUS Corp., Rockville, MD). Trans. Am. Nucl. Soc.; 22: 146(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19667 ON-LINE NONDESTRUCTIVE PAPER CHEMISTRY ANALYSIS BY X-RAY FLUORESCENCE. Buchnea, A. (Sentrol Systems Ltd., Downsview, Ont.); Cohen, G. E.; Hewitt, J. S. Trans. Am. Nucl. Soc.; 22: 146-148(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19668 α-PARTICLE ASSAY USING LIQUID-SCINTILLATION SPECTROSCOPY. McKlveen, J. W. (Arizona State Univ., Tempe); McDowell, W. J. Trans. Am. Nucl. Soc.; 22: 149-150(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19669 COMPOSITION MEASUREMENTS OF MATERIAL MIXTURES USING LOW-ENERGY γ BACKSCATTER. Kurstedt, H. A. Jr.; Vantrease, J. O. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA). Trans. Am. Nucl. Soc.; 22: 152-153 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19670 CALIBRATION FACTORS FOR REACTOR OFF-GAS SAMPLES RELATIVE TO NBS SAMPLES. Frigerio, N. A. (Argonne National Lab., IL); Coley, R. F. Trans. Am. Nucl. Soc.; 22: 156(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19671 FUEL PARTICLE INSPECTION WITH AN IRRADIATED MICROSPHERE GAMMA ANALYZER. Valentine, K. H.; Long, E. L. Jr. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 213-214(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19672 DETERMINATION OF LOW ^{226}Ra ACTIVITIES IN WATER. Sladkova, M.; Abel, E.; Evan, J.; Chrapan, J.; Oravec, J.; Holy, K. Cesk. Hyg.; 19: No. 10, 480-484(1974). (In Czech).

Basically the methods for the determination of ^{226}Ra are either direct based on previous radiochemical separation, or indirect using some of ^{226}Ra decay products. A brief survey is presented of the methods and their modifications from both groups. For the determination of low ^{226}Ra activities in water two methods were compared: the separation method of concurrent radium precipitation with barium and lead sulfates, and the method using ^{222}Rn as a decay product. In the first case, the sample activity was measured on a low-background flow counter Biospan model 4336 of Nuclear Chicago, for the second case a large volume corrone counter was constructed, it being suitable for the measurement of ^{222}Rn activities. The working characteristics of both counters are described. The minimum measurable activities is of the order 10^{-3} s^{-1}. (Czech. Biblio.)

19673 LOSS OF ^{32}P-PHOSPHATE AND ^{14}C-CARBONATE ACTIVITY DURING LIQUID SCINTILLATION COUNTING OF AQUEOUS SAMPLES. Weimer, W. C.; Rodel, M. G.; Armstrong, D. E. (Univ. of Wisconsin, Madison). Environ. Sci. Technol.; 9: No. 10, 966-972(Oct 1975).

Loss of radioactivity in excess of natural decay was observed in aqueous samples of ^{32}P–PO_4^{-3} and ^{14}C–CO_3^{-2} counted by liquid scintillation in a dioxane-base counting solution. Loss of ^{32}P–PO_4^{-3} activity was increased by the presence of the HCO_3^- ion and ranged up to 23 percent in 8 hr and 46 percent in 4 days. Common solubilizing agents were ineffective in preventing ^{32}P–PO_4^{-3} loss and only partially effective in preventing ^{14}C–CO_3^{-2} loss. The ^{32}P–PO_4^{-3} activity was recovered by shaking and recounting the sample, but ^{14}C–CO_3^{-2} activity was incompletely recovered. Settling of insoluble materials within the counting solution apparently was responsible for ^{32}P–PO_4^{-3} activity loss. A dual mechanism of precipitation of ^{14}C–CO_3^{-2} and volatilization of ^{14}C–CO_2 was responsible for ^{14}C loss. Acidification of the counting solution prevented ^{32}P–PO_4^{-3} activity loss; addition of phenethylamine to the counting solution prevented volatilization of ^{14}C–CO_2, but no treatment was found to prohibit ^{14}C–CO_3^{-2} precipitation. (auth)

19674 INFLUENCE OF NONSTATISTICAL VARIATIONS ON LOW-LEVEL MEASUREMENTS OF ^{131}I IN MILK. Matuszek, J. M.; Paperiello, C. J. (New York State Dept. of Health, Albany). Nucl. Technol.; 27: No. 3, 514-522(Nov 1975).

The procedure described in the U. S. Atomic Energy Commission Regulatory Guide 4.3, which is intended to keep ^{131}I levels in milk "as low as practicable," does not properly account for all sources of analytical error that can occur in a low-level radiochemical procedure. Inaccurate chemical recovery factors due to large amounts of stable iodine in milk and incomplete evaluation of detector background fluctuations are the sources of largest error. Significant errors are also contributed in incorrect application of factors for protein-bound iodine and counting efficiency. Ambient levels of ^{131}I contribute to difficulties in evaluating the local impact of any reactor. Use of a beta/gamma coincidence system for counting ^{131}I, measurement of the stable iodine in milk samples and collection of control samples remote from any site are among the

recommendations provided to ensure compliance with the Regulatory Guides.

Separation Procedures

Refer also to abstract 20426.

19675 (MLM-2003(tr)) COLUMN CHROMATOGRAPHIC SEPARATION OF PLUTONIUM OXIDATION STATES WITH THE SYSTEM AG 50 X 8/HCl. Specht, S.; Hoehlein, G. Translated by H. W. Kirby from Radiochim. Acta; 12: 38-42(1969). 12p. Dep. NTIS $3.50.

An analytical method of column chromatography is described which permits the identification, with tracer amounts of plutonium, of the states of oxidation III, IV, and VI, which occur side by side, and of the colloidal plutonium present. The method employs the cation exchange resin AG 50 X 8 (300 and 400 mesh) and HCl as the eluant. The identification is based on the position of the elution bands obtained. The distribution coefficients K/sub d/, the separation factors alpha, the plate numbers N, and the HETP-values are shown as a function of HCl concentration and the optimum conditions of separation are discussed by examples. For comparison, the K/sub d/ values obtained for americium, sodium, and the rare earth metals praseodymium and europium are also mentioned. (auth)

19676 (ORO-1797-62) THERMODYNAMICS OF SYNERGISTIC SOLVENT EXTRACTION OF ZINC(II). Nash, K. L.; Choppin, G. R. (Florida State Univ., Tallahassee (USA)). 1975. 17p. Dep. NTIS $3.50.

The thermodynamics of the synergistic solvent extraction of zinc(II) by TTA-TBP mixtures were studied using radiochemical techniques. The thermodynamic values of the extraction equations indicate that the mechanism of adduct formation by TBP with the $Zn(TTA)_2$ chelate involves expansion of the coordination number of the central metal ion from 4 to 5. The extraction of zinc(II) by DEHP-TBP mixtures was also studied but no synergistic effect was seen in this extraction system. (auth)

19677 EXTRACTION-CHROMATOGRAPHIC SEPARATION OF LANTHANUM, CERIUM, AND NEODYMIUM MIXTURES. Vasilev, Kh.; Faitondzhiev, L. P.; Khavezov, I. P. Khim. Ind. (Sofia); 47: No. 1, 22-24(1975). (In Bulgarian).

The separation of La, Ce, and Nd mixtures by the extraction-chromatographic technique as a preliminary step in the separate determination of these elements in minerals, ores, and alloys was studied. The separation was carried out in a bis(2-ethylhexyl) phosphate HCl solution incorporating a chromosorb. The HCl content of the solution was a vital factor in determining the efficiency of the separation; for any particular mixture a few trial runs with different HCl contents were initially required to establish optimum conditions. Worked examples are presented for some artificial mixtures. (Metals Abstr.)

19678 SEPARATION OF RHENIUM FROM MOLYBDENUM IN ACIDIC AND NEUTRAL SULFATE MEDIA. Borisova, L. V.; Zarinskii, V. A.; Prasolova, O. D.; Konovalov, E. A.; Krein, O. E. (Inst. of Geochemistry and Analytical Chemistry, Moscow). J. Appl. Chem. USSR (Engl. Transl.); 48: No. 5, 1020-1022(May 1975).

Translated from Zh. Prikl. Khim.; 48: No. 5, 970-972(May 1975).

The separation of rhenium from anionic and cationic impurities by electrodialysis was investigated. Neutral and acidic sulfate solutions close to industrial liquors in composition were chosen as the media. It is concluded that Re and Mo can be successfully separated much more rapidly in neutral and alkaline media than in acidic media. The use of bipolar membranes makes the separation of Mo and Re by electrodialysis possible. According to the results of spectral analysis, various impurity cations (Cu^{2+}, Fe^{2+}, Ni^{2+}, Ca^{2+}) are removed completely from Re if the electrodialysis is conducted under the specified conditions (25g H_2SO_4 and 0.5g Re per liter, total impurity content 0.05g/liter). (JGB)

19679 SORPTION OF AMERICIUM IN DIFFERENT OXIDATION STATES BY IRON AND ZIRCONIUM HYDROXIDES. Goncharova, L. K.; Myasoedov, B. F.; Novikov, A. I. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 312-315(1974).

Translated from Radiokhimiya: 16: No. 3, 308-312(1974).

A study was made of the sorption of tracer amounts of americium in different oxidation states on iron and zirconium hydroxides and iron oxide in relation to a series of conditions. The experimental data on the sorption of Am by hydroxides were compared with calculated data on the state of Am ions in solutions; the sorption processes of Am by hydroxides are explained from the point of view of the coordination chemistry of the interaction. The pH regions were determined for concentration of Am from dilute aqueous solutions by its sorption on the carriers studied. It was found that Am(III) and Am(V) may be separated by sorption on zirconium hydroxide from weak acid solutions. (auth)

19680 SORPTION BEHAVIOR OF AMERICIUM FROM AMMONIUM ACETATE SOLUTIONS ON ANION EXCHANGE RESINS. Laskorin, B. N.; Khalturin, G. V.; Borovinskii, V. A. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 320-323(1974).

Translated from Radiokhimiya: 16: No. 3, 316-320(1974).

An investigation was made of the behavior of Am in ammonium acetate solutions on the anion exchange resins AM × 2, AM × 4, AM × 10, and AM × 12P. It was found that the distribution coefficients increase with an increase in the solution pH and a decrease in the percent divinylbenzene in the resin. A study was made of the kinetic characteristics of the anion exchange resins in ammonium acetate solutions with respect to Am. It was established that porous resins have higher kinetic characteristics and that the rate of sorption of Am on styrene-divinylbenzene resins increases with a rise in the solution temperature and a decrease in the percent divinylbenzene in the resin. It was established experimentally that the sorption of Am in styrene-divinylbenzene anion exchange resins from ammonium acetate solution proceeds by a gel kinetic mechanism. (auth)

19681 ION EXCHANGE IN UO_2F_2-HF($NH_4 \cdot HF$, NH_4F)-H_2O SOLUTIONS ON KU-2 CATIONITE IN SORPTION AND DESORPTION PROCESSES. Pakholkov, V. S.; Ganyaev, V. P.; Syskov, E. A. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 324-328 (1974).

Translated from Radiokhimiya: 16: No. 3, 320-325(1974).

A study was made of the sorption of uranium under dynamic conditions from a solution of UO_2F_2 by the cationite KU-2 × 8 in relation to the concentration of HF, NH_4F, and $NH_4F \cdot HF$. In the sorption of uranium from a solution containing NH_4F or $NH_4F \cdot HF$ it was established that in the saturation of the cationite the initially sorbed UO_2^{2+} ions are displaced from it by ammonium ions as a result of the formation of the sparingly-dissociated compound UO_2F_2. This behavior characteristic was used to free uranium from ions of ammonium, sodium, heavy metals, and other elements. A study was made of the desorption of uranyl ions from the cationites KU-2 × 2, KU-2 × 4, KU-2 × 8, and KU-2 × 12P by solutions of HF, HCl, H_2SO_4, NH_4Cl, and $(NH_4)_2SO_4$ of various concentrations. The efficiencies of regeneration were calculated. Ion exchange methods of freeing uranyl fluoride solutions from traces of other elements and radioactive isotopes were examined and checked in special experiments. (auth)

19682 EXTRACTION OF RUTHENIUM WITH DIANTIPYRYLPROPYLMETHANE. Kolmakova, A. I.; Kordyukevich, V. O.; Rudenko, N. P. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 352-355(1974).

Translated from Radiokhimiya: 16: No. 3, 351-355(1974).

A study was made of the extraction of ruthenium from chloride, sulfate, and iodide solutions by chloroform, dichloroethane, and nitrobenzene solutions of diantipyrylpropylmethane in relation to the concentration of the reagent, ruthenium, and acid. A hypothesis is proposed on the composition of the ruthenium compound extracted: it is an ionic associate and depending on the acid concentration its cation is singly or doubly protonized diantipyrylpropylmethane, while the ruthenium is present in the complex as an acido anion. (auth)

19683 SCANDIUM EXTRACTION WITH SOME DIALKYL PHOSPHORIC ACIDS FROM PERCHLORATE AND NITRATE MEDIA. Navratil, O.; Linhart, P. (Purknye Univ. Brno). Collect. Czech. Chem. Commun.; 40: No. 11, 3436-3442(Nov 1975).

The distribution of ^{46}Sc between aqueous solution of $HClO_4$ and $NaClO_4$ or HNO_3 and $LiNO_3$, as well as between solution of di-n-butylphosphoric acid in benzene, and di-2-ethylhexylphosphoric acid and di-n-octylphosphoric acid in octane, was investigated. The investigation of the dependence of the Sc distribution behavior on the hydrogen ion concentration and equilibrium concentration of the dialkylphosphoric acids HA in the aqueous phase showed that the Sc was extracted into the organic phase in the form of the complex $ScA_3(HA)_3$. In strongly acid perchloric acid medium (> 5M) a change from the ion exchange mechanism to the solvation mechanism occurs and the extracted complex has the composition $Sc(ClO_4)_3(HA)_3$. The Sc extractability increases with the length of the carbon chain in the HA, but decreases with its branching. The extraction constants were determined. In Sc extraction from mixtures of $HClO_4$ and HNO_3 there is no synergistic effect and, in contrast, in some case antagonism was observed. (tr-auth)

19684 EXTRACTION OF NIOBIUM (V), TANTALUM(V), MERCURY(II), SILVER (I), COBALT(II), IRON(III), AND CADMIUM(II) BY DI(N-OCTYL)ARSENIC ACID (HDOAA) IN CHLORO-

FORM. Dominguez, R.J.G. College Station; Texas A and M Univ. (1975). 149p. University Microfilms Order No. 75-25,091.

Thesis (Ph. D.).

The extraction of Nb(V) and Ta(V) from HCl, H_2SO_4, and $H_2C_2O_4$ solutions, Hg(II) from HCl solutions, Ag(I) from HNO_3 solutions, Co(II) from HCl solutions, Fe(III) from HCl, HNO_3, H_2SO_4 and $HClO_4$ solutions and Cd(II) from HCl solutions by 0.1 M solutions of dioctylarsinic acid, $(n\text{-}C_8H_{17})_2AsOOH$ (HDOAA) in chloroform was investigated. The extraction of these metal ions was studied as a function of the equilibrium aqueous phase pH and the reagent concentration using radionuclides as tracers. In the niobium and tantalum extraction experiments the oxalates $MO(OH)C_2O_4$ (M equals Nb, Ta) were employed. The extraction of mercury(II) from aqueous solutions of HCl concentration 8 less than [HCl] less than 1.0×10^{-6} M and from solutions with 7 less than pH less than 9.3 was studied. The extraction of silver(I) from HNO_3 solutions with 1 less than pH less than 6 and from aqueous solutions with 7 less than pH less than 8 was studied. A precipitate formed at the interface in all of these extractions preventing the determination of E^0/sub a/. The extraction of cobalt(II) from aqueous solutions of HCl concentration 2 less than HCl M less than 10 and in the range 0 less than pH less than 8.6 was studied. The pH dependence indicated a second power dependence of E^0/sub a/ on pH and the reagent dependence indicated a 1.5 power dependence on the HDOAA concentration. The cadmium(II) system was very similar to the cobalt system in that no extraction was observed in the range 1 less than pH less than 8. At pH less than 8 the E^0/sub a/ rose sharply to a maximum value of 22 at pH 9.5. The extraction of iron(III) from HCl and H_2SO_4 solutions with 0 less than pH less than 2.5 and from aqueous, HCl solutions with 1 less than acid concentration less than 10 M and from aqueous H_2SO_4, HNO_3 and $HClO_4$ solutions in the range 4 less than acid concentration less than 8 was studied. (JGB)

Inorganic, Organic, and Physical Chemistry

19685 (UCRL-34P218X2) MULTIHETEROMACROCYCLES THAT COMPLEX METAL IONS. Second Progress Report, 1 May 1975-30 April 1976. Cram, D. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1976. Contract AT(04-3)-34. 22p. Dep. NTIS $3.50.

Objective is to develop cyclic and polycyclic host organic compounds to complex and lipophilize metal ions. Macrorings were synthesized: $(OCH_2\ CH_2\ O\ CH_2\ COCH_2\ COCH_2)_2$ and $(OCH_2\ CH_2\ O\ CH_2\ COCH_2\ COCH_2)_3$. The smaller ring complexes divalent metals $10^{1.9}$ times better than the open-chain model $CH_3\ O\ CH_2\ CO\ CH_2\ COCH_2\ O\ CH_3$, and the order in which metal ions are complexed is Cu^{2+}, UO_2^{2+} greater than Ni^{2+} greater than Fe^{2+}, Co^{2+}, Zn^{2+}, Cd^{2+} greater than Mn^{2+}. The UO_2^{2+} and Cu^{2+} complexes were isolated and characterized. The larger ring complexes trivalent metals $10^{0.9\text{-}1.7}$ times better than the open-chain model compound, and the order is La^{3+}, Ce^{3+} greater than Cr^{3+}. Five other macrocycles were also synthesized, and their binding constants with Na, K, NH_4, and Cs picrates were measured. Six compounds containing one macroring and two inward-pointing ArOH or $ArOCH_2$ groups were also prepared and tested for binding of Li, Na, K, Rb, and NH_4 picrates. Racemic compounds containing two binaphthyls and its sulfur analog were prepared. Cage-shaped multiheteromacrocycles containing ten O ligand sites or four S and six O ligand sites were prepared and the binding capability of the first compound for picrates studied. Two ring systems with phosphonate ester groups were also prepared. (DLC)

19686 RAMAN, INFRARED, AND MICROWAVE SPECTRA AND STRUCTURES OF SOME PHOSPHORUS–BORON COMPOUNDS. Kalasinsky, V. F. Columbia, SC; Univ. of South Carolina (1975). 147p. University Microfilms Order No. 75-28,973.

Thesis (Ph. D.).

The infrared (70-2700 cm^{-1}) and Raman (25-2500 cm^{-1}) spectra of H_3PBH_3, H_3PBD_3, D_3PBH_3, and D_3PBD_3 in the solid state at -196^0C were recorded. The shift associated with the ^{10}B and ^{11}B isotopes was observed for the P–B stretching motion. A complete vibrational assignment is proposed and a normal coordinate calculation utilizing a valence force field model has been carried out. The force constant of 1.97 mdyn/A for the P–B stretching mode is consistent with the relatively long P–B bond; this constant is compared to the similar quantity for several other phosphorus-boron compounds. None of the E modes for the free molecule were found to be split. The number of observed lattice modes is not consistent with the previously reported crystal structure for this molecule. A possible explanation is discussed. The infrared (80-3200 cm^{-1}) and Raman (25-3200 cm^{-1}) spectra of $CH_3PH_2BH_3$, $CH_3PH_2BD_3$, $CH_3PD_2BH_3$, and CH_3PD_2-BD_3 in the solid state at -196^0C and Raman spectra of the liquid at room temperature were recorded. A complete vibrational assignment is proposed and a normal coordinate calculation utilizing a valence force field model has been carried out. The Raman (25-2500 cm^{-1}) and infrared (90-2500 cm^{-1}) spectra of solid $B_2Cl_4 \cdot 2PH_3$ and $B_2Cl_4 \cdot 2PD_3$ were recorded. The vibrational data were interpreted on the basis of a trans (C_2/sub h/) molecular conformation in the solid state. The microwave spectra in the R band of 4 isotopic symmetric top species of phosphine–trifluoroborane (H_3PBF_3) were observed. The infrared (33-3000 cm^{-1}) and Raman (20-2700 cm^{-1}) spectra of H_3PBX_3 and D_3PBX_3 (where X equals F, Cl, Br, and I) in the solid state at -196^0 were also recorded. The spectra were interpreted on the basis of C_3/sub v/ symmetry and at least eleven of the twelve fundamental vibrations were assigned. (JGB)

Chemical and Physicochemical Properties

Refer also to abstracts 19747, 19752, 19754, 19774, 20679, 20723, and 20743.

19687 (AECL-4919) STUDY OF THE HYDROLYSIS OF URANIUM MONOCARBIDE. Part III. Radioiodine Species Formed During the Hydrolysis of Irradiated Uranium Carbide with Water. Dyck, R. W.; Boase, D. G.; Gerwing, A. F. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1975. 33p. Dep. NTIS (US Sales Only) $4.00. AECL $1.00.

The fate of radioiodine during the hydrolysis of irradiated uranium carbide with water at 25 and 75°C was studied to aid in the assessment of the probable effects of loss-of-coolant in an organic-cooled reactor, in which the fuel may be exposed to the heavy water moderator. Only small amounts of iodine-131 were released to the gas phase, and the bulk of the iodine remained in the aqueous phase and in the uranium dioxide hydrolysis residue. The chemical species of radioiodine occurring in the gaseous and aqueous phases and the relative amounts of each were determined. The analysis procedures used are described in detail. (NSA)

19688 (ORNL/TM-5115) STATEQ: A NONLINEAR LEAST-SQUARES CODE FOR OBTAINING MARTIN THERMODYNAMIC REPRESENTATIONS OF FLUIDS IN THE GASEOUS AND DENSE GASEOUS REGIONS. Milora, S. L. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 132p. Dep. NTIS $7.00.

The use of the code NLIN (IBM Share Program No. 1428) to obtain empirical thermodynamic pressure-volume-temperature (P-V-T) relationships for substances in the gaseous and dense gaseous states is described. When sufficient experimental data exist, the code STATEQ will provide least-squares estimates for the 21 parameters of the Martin model. Another code, APPROX, is described which also obtains parameter estimates for the model by making use of the approximate generalized behavior of fluids. Use of the codes is illustrated in obtaining thermodynamic representations for isobutane. (auth)

19689 (ORNL-tr-4082) THERMODYNAMIC FUNCTIONS FOR COMPLEX FORMATION AND IONIC RADII. III. Statistical-thermodynamic Analysis of the Complex-Formation Constants in Aqueous Solutions. Muenze, R. Translated by E. G. Silver from Z. Phys. Chem. (Leipzig); 256: No. 4, 617-624(1975). 12p. Dep. NTIS $3.50.

Using simple potentials for the interaction between the reactants the conditions for the application of the experimentally verified equation between the ionic charges, ionic radii and polarizabilities for the reaction of complex formation in aqueous solution have been evaluated by statistical thermodynamics. The result permits conclusions concerning the transfer of such equations to other solvent systems. (auth)

19690 CHEMILUMINESCENCE FROM THALLIUM–FLUORINE REACTIONS. Maya, J.; Nordine, P.C. (Department of Engineering and Applied Science, Yale University, New Haven, Connecticut 06520). J. Chem. Phys. 64: No. 1, 84-88 (1 Jan 1976).

Chemiluminescence from reactions of thallium with fluorine has been observed in a dilute flame experiment. Atomic emission from the highest observed Tl ($6\,^2D_{5/2,3/2}$) states (103.5 kcal above ground state) is shown to arise from energy transfer processes. The role of the metastable Tl ($6\,^2P_{1/2}$) state in energy transfer processes is discussed. Weak molecular emission from TlF ($A\,^3\Pi$–$X\,^1\Sigma$, $B\,^3\Pi$–$X\,^1\Sigma$) has been observed. (auth)

19691 SOLUBILITY AND THERMAL DECOMPOSITION OF Li_3N IN LIQUID LITHIUM. Yonco, R. M. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 159-160(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Isotope Effects

Refer also to abstracts 20468, 21114, 21173, 21207, 21213, and 21215.

19692 (TID-26949) HYDRIDE SHIFTS IN THE 2-NORBORNYL CATION. Schmidt, W. W. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. 89p. Dep. NTIS $5.00.

Thesis.

Deuterium labeling was used in two separate but related solvolyses to evaluate endo,endo-6,2-hydride (6,2-H) and exo,exo-3,2-hydride (3,2-H) shifts in the 2-norbornyl cation. (auth)

19693 (UCLA-34P102-53) ISOTOPIC STUDIES ON STRUCTURE-FUNCTION RELATIONSHIPS OF NUCLEIC ACIDS AND ENZYMES. Three Year Progress Report, May 1972-October 1975. Boyer, P. D. (California Univ., Los Angeles (USA)). 1975 Contract AT(04-3)-34. 19p. Dep. NTIS $3.50.

The most important accomplishments and major contributions are tabulated with citations to published work. The more important unpublished contributions deal with the early events in ATP formation by chloroplasts, energy linkage in reaction steps of oxidative phosphorylation, molecular integrity of parental DNA, bound pyrophosphate and ^{18}O-exchanges by inorganic pyrophosphatase, and glutamine synthetase exchanges and mechanisms. These are being prepared for publication. (JSR)

19694 SOME OPTICAL PROPERTIES OF HIGH-DENSITY WATER VAPORS. Vetrov, A.A.; Yukhnevich, G.V. Opt. Spectrosc. (USSR) 39: No. 3, 273-275 (Sept 1975).

The absorption spectra of stretching vibrations of H_2O, HDO, and D_2O vapor and bending vibrations of H_2O vapor are measured at densities of 0.003-0.11 g/cm^3. Absorption due to associated water molecules is identified. The absolute absorption band intensities of monomers and complexes are determined. The solution of the inverse spectral problem indicates that proton donor molecules forming a single hydrogen bond are present in water vapor at densities up to 0.11 g/cm^3. (auth)

19695 NEUTRON DIFFRACTION STUDY OF HEXAAMINE-d_3-CALCIUM(0) AT 75K. Von Dreele, R. B. (Arizona State Univ., Tempe); Glaunsinger, W. S.; Bowman, A. L.; Yarnell, J. L. J. Phys. Chem.; 79: No. 26, 2992-2995(18 Dec 1975).

The structure of $Ca(ND_3)_6$ was determined by powder neutron diffraction at 75^{0}K. The atomic parameters were refined by least-squares fitting of the diffraction profile. $Ca(ND_3)_6$ crystallizes in the space group Im3m with a equals 9.0137(4) A and Z equals 2. The standard profile residual was 0.109 for eight parameters and a profile range 10^0 less than or equal to 2 theta less than or equal to 50^0 for lambda equals 1.27963 A. $Ca(ND_3)_6$ has highly distorted ND_3 molecules arranged in an exact octahedron around the Ca atoms with fourfold rotational disorder for each ND_3. The Ca-N distance is 2.69 A. One N-D bond is normal, 0.94 A, while the other two are extremely long, 1.39 A. There is no hydrogen bonding in the structure and virtually all nonbonded contacts are greater than van der Waals distances. (auth)

19696 HYDROGEN ABSTRACTION REACTIONS BY ATOMIC FLUORINE. IV. TEMPERATURE DEPENDENCE OF THE INTERMOLECULAR KINETIC ISOTOPE EFFECT FOR THE NONTHERMAL $^{18}F+H_2$ REACTION. Grant, E.R.; Root, J.W. (Department of Chemistry and Crocker Nuclear Laboratory, University of California, Davis, California 95616). J. Chem. Phys. 64: No. 1, 417-426 (1 Jan 1976).

The nuclear recoil systems ^{18}F vs H_2/C_3F_6 and ^{18}F vs D_2/C_3F_6 were investigated from 273-347 °K over the full range of mixture compositions at a constant pressure of 1000 Torr. The results were systematized and interpreted within a nonthermal bimolecular rate constant framework. The phenomenological rate constants as well as their purely non-Boltzmann components exhibited significant composition and ambient temperature dependences. Most, if not all, of this latter effect was attributable to the $^{18}F^* + C_3F_6$ reaction channel, either through an internal state coupling mechanism or through secondary decomposition of excited $CF_3CFCF_2{}^{18}F$ radicals by ^{18}F-atom loss. Preferred values for the thermal reaction fractions in extrapolated pure H_2 (or D_2) and C_3F_6 systems were 20±10% and 20±20%. The corresponding average intermolecular kinetic isotope effect for the pure non-Boltzmann $^{18}F+H_2$ reaction was 1.3±0.1. (auth)

19697 CALCULATIONS ON THE HCl-Ar VAN DER WAALS COMPLEX. Dunker, A.M.; Gordon, R.G. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). J. Chem. Phys. 64: No. 1, 354-363 (1 Jan 1976).

Previously determined anisotropic intermolecular potentials for HCl-Ar are tested for comparison with the recent molecular beam resonance experiments on the van der Waals complexes. The Schrödinger equation for the coupled rotational and vibrational motion of the complex is solved accurately by a close coupling method. Energy levels, and expectations of the dipole moment, $\cos\theta$, and $\cos^2\theta$, where θ is the Ar-HCl center of mass-H angle, have been computed for the lower states of ^{40}Ar complexes with $H^{35}Cl$, $H^{37}Cl$, $D^{35}Cl$, and $D^{37}Cl$. Rotational and centrifugal distortion constants were also computed for the lowest level. The assignment of the angle θ is discussed, and our results support the acute choice (i.e., H on the average between the Cl and Ar nuclei). The shift in angular expectations with HCl isotope distinguishes between the potentials tested here, and comparison with the experiments suggests that the true potential has an absolute minimum near $\theta=0°$. However, none of the available potentials fits both the scattering data and the bound state spectroscopic data quantitatively. This demonstrates that the simultaneous analysis of scattering and bound state data constrains the potential much more than either alone. (auth)

19698 HIGH-TEMPERATURE THERMODYNAMICS OF THE Ti-H_2 AND Ti-D_2 SYSTEMS. Dantzer, P.; Kleppa, O.J.; Melnichak, M.E. (The James Franck Institute and Department of Chemistry, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 64: No. 1, 139-147 (1 Jan 1976).

The high-temperature thermodynamic properties of the Ti+H_2 and Ti+D_2 solid systems have been studied by a combined calorimetric and equilibrium method at 706-721 K (both systems) and 971 K (Ti+H_2 only). The limiting enthalpies of solution of hydrogen in close-packed hexagonal α-Ti is -10.6 kcal mole^{-1}(H) at the lower temperature, and about -10.9 kcal mole^{-1}(H) at the higher temperature. The corresponding value of $\Delta\bar{H}_D$ at 707 K is -10.1 kcal mole^{-1}(D). From the hydrogen and deuterium data at 707-721 K we estimate $\bar{\nu}_H$ in α-Ti to be about 800 cm^{-1} and $\bar{\nu}_D$ about 565 cm^{-1}. The equilibrium pressures and the partial enthalpies of hydrogen and deuterium allow an evaluation of the partial entropies and *excess* entropies, $\bar{S}^E_H$ and $\bar{S}^E_D$. The limiting value of $\bar{S}^E_H$ at $N_H \simeq 0$ and 706-721 K is 6.5 cal K^{-1}·mole^{-1}(H), that of $\bar{S}^E_D$ at the same temperature is 8.9 cal K^{-1}·mole^{-1}(D). These values are larger than corresponding values calculated from $\bar{\nu}_H$ and $\bar{\nu}_D$. This discrepancy suggests either much lower vibrational frequencies (than calculated from $\Delta\bar{H}_H$ and $\Delta\bar{H}_D$), or perhaps a very significant communal entropy term. (auth)

19699 THE MUTUAL DIFFUSION STUDY IN THE SYSTEMS CONTAINING BENZENE OR BENZENE-d_6 AT 25°. Albright, J.G.; Aoyagi, K. (Department of Chemistry, Texas Christian University, Fort Worth, Texas 76129). J. Chem. Phys. 64: No. 1, 81-83 (1 Jan 1976).

The mutual diffusion coefficients of benzene and benzene-d_6 were measured at low solute concentrations in each of the following solvents: *n*-hexane, cyclohexane, dodecane, and hexadecane. The observed mutual diffusion coefficients for the systems containing benzene-d_6 were consistently lower than those observed for the corresponding systems containing benzene. The results of this investigation show that a measurable isotope effect exists in liquid diffusion and that the magnitude of the effect depends on the physiochemical properties of the solvents. The magnitude appears to be more closely related to the viscosity of the solvents than to the molecular weights of the solvents. (auth)

19700 ON THE ULTRAVIOLET SPECTRUM OF TRANS-1,3-BUTADIENE. McDiarmid, R. (Laboratory of Chemical Physics, National Institute of Arthritis, Metabolism and Digestive Diseases, National Institutes of Health, Bethesda, Maryland 20014). J. Chem. Phys. 64: No. 2, 514-521 (15 Jan 1976).

The ultraviolet absorption spectra of *trans*-1,3-butadiene, 1,1,4,4-*trans*-1,3-butadiene-d_4, and *trans*-1,3-butadiene-d_6 between 2300 and 1350 Å have been recorded and analyzed. Four Rydberg series were identified (δ=0.087, 0.21, 0.42, and 0.67). A transition-by-transition comparison of this analysis with those in the literature shows that several of the previously assigned transitions are misidentified. A continuum originating around 1450 Å is reported. (auth)

19701 STRUCTURAL PHASE TRANSITIONS IN SOLIDS WITH APPLIED STRESSES AND FIELDS, AND EFFECT OF ISOTOPIC IMPURITIES ON THE FREE ENERGY. Allen, R.E. (Department of Physics, Texas A&M University, College Station, Texas 77843). J. Chem. Phys. 64: No. 2, 552-553 (15 Jan 1976).

Subject to the assumptions described in the text, we obtain the following expression for the transition temperature T_c associated with a structural phase transition: $T_c = \alpha\,(\Delta U + \Sigma_i P_i \Delta a_i)/k_B$, $\alpha \equiv 2/\ln(|\Phi|/|\Phi'|)$. Here ΔU is the change in energy, the P_i are given by the pressure, stresses, and applied fields, the Δa_i are given by the changes in volume, strains, and dipole moments, and $|\Phi|$ is the determinant of the force constant matrix. We also give a result which may be useful for solids containing isotopic impurities: At high temperatures and in the harmonic approximation, $\Delta G = -(3/2)\,k_B T \Sigma_k \ln(m_k'/m_k)$, where Δ

G is the change in Gibbs free energy when some of the particle masses are changed from m_k to $m_{k'}$. (auth)

19702 RAMAN SCATTERING STUDY OF THE SOLID PHASES OF HCl, DCl, HBr, AND DBr. Vesel, J. E. Waterloo, Ont.; Univ. of Waterloo (1975). Vp. Univ. of Waterloo Library.

Thesis (Ph. D.).

Raman scattering studies were carried out on the ferroelectric and paraelectric phases of HCl, DCl, HBr and DBr at temperatures from ~72 K to ~160 K. Changes in the lattice region spectra at temperatures near T_c confirm the order-disorder nature of the ferroelectric transitions and the importance of anharmonic effects in these materials. The structural transition occurring in HCl near 120 K was observed by internal mode depolarization measurements which change irreversibly; these changes are attributed to macroscopic disorder in the sample below this temperature. Observations on the internal modes of HBr show a thermal hysteresis around an intermediate cubic phase and analogous results obtained for DBr imply the existence of a new phase which is similar to the intermediate phase in HBr. The ferroelectric and proposed paraelectric phases of these materials have been studied using a lattice of molecules which are represented by a set of electric multipoles. This model shows the dominance of quadrupole-quadrupole interactions and the importance of other multipole interactions which affect the librational motions of these molecular crystals. A dynamic ferroelectric phase model was used to calculate the four librational modes–with moderate success. (Abstr. Int., B.)

19703 ANOMALOUS ISOTOPE EFFECT FOR THE FREQUENCY OF THE ν(AH) STRETCHING VIBRATIONS IN STRONG HYDROGEN BONDS A–H...B. Savel'ev, V. A.; Sokolov, N. D. (Inst. of Chemical Physics, Moscow). Dokl. Phys. Chem. (Engl. Transl.); 221: No. 4-6, 374-377(Apr 1975).

Translated from Dokl. Akad. Nauk SSSR; 221: No. 5, 1122-1125 (Apr 1975).

Published experimental data are analyzed to explain the anomalous isotopic effect for the ν(AH) frequency. The analysis shows that there is an internal relationship between the isotopic effects for the ν(AH) frequency and for the equilibrium length in the A–H....B system. The interaction between the A–H and A....B stretching vibrations is the chief factor responsible for both the observed displacement of the frequency ν(OH) on the formation of the hydrogen bond and for the isotopic effects for the frequency ν and the equilibrium length R_0. (JSR)

Isotope Exchange and Isotope Separation

19704 (UCRL-Trans-10994) HETEROGENEOUS ION-EXCHANGE REACTIONS ON SILVER SALTS. Reber, K. Translated from Photographische Korrespondenz; 105: No. 11, 175-179(1969). 16p. Dep. NTIS $3.50.

The kinetics of heterogeneous ion exchange reactions on thin AgBr crystals with Ag^+-solution were investigated using ^{110m}Ag; they are controlled by the speed of the interface reaction as well as by the self-diffusion coefficient in the solid D/sup S/. Both increase with increasing Ag^+-concentration, D/sup S/ from $5.2 \cdot 10^{-11}$ to $1.2 \cdot 10^{-9}$ cm^2/hour in the P/sub Ag/ range between 6.2 and 2.7. The interface reaction is not affected by adsorbed substances. The exchange kinetics of the system silver behenate and Ag^+ in solution is controlled solely by the diffusion in the solid. D/sup S/ is about 10^{-12} cm^2/hour. Between AgBr and $^{109}Cd^{2+}$ in solution no exchange occurs, neither are Cd^{2+}-ions adsorbed on (100) faces when their concentration is very small (10^{-9} molar). (auth)

19705 ISOTOPIC EXCHANGE REACTIONS OF OXIDES OF NITROGEN WITH NITRIC ACID, NITRATE IONS, AND OXYCHLORIDES OF NITROGEN. Sood, S. P. Waterloo, Ont.; Univ. of Waterloo (1975). vp. Univ. of Waterloo, Ont.

Thesis (Ph. D.).

The kinetics of the exchange reaction in $NO_2(N_2O_4)$–HNO_3; NO, NO_2–HNO_3; and, NO, NO_2–NOCl systems in the gas phase and $NO_2(N_2O_4)$–HNO_3 and N_2O_4–$Cu(NO_3)_2$ in solution were studied by using a time-of-flight mass spectrometer. The homogeneous exchange reaction between $NO_2(N_2O_4)$ and HNO_3 was studied over a temperature range of –20-40°C. The exchange rate constant shows a negative temperature dependence which can be expressed as 1.1×10^{-5} exp(7194/T) M^{-2} sec^{-1} over a temperature range of 0-40°C, but below 0°C it deviates from the above expression and appears to approach a maximum value. A mechanism of exchange, compatible with the earlier studies of $N^{15}O_2$-$N^{18}O_2$ self-exchange reactions is proposed. The observed exchange rate constant is given. The observed temperature dependence was attributed to the recombination reaction rate constant, k_{-3}. There is evidence that k_{-3} does not follow the usual Arrhenius law. The exchange reaction between $Cu(NO_3)_2$ and N_2O_4 in ethyl acetate has been studied by using a flow reactor. The exchange reaction between N_2O_4 and HNO_3 was studied in two solvents, viz., cyclohexane and ethyl acetate. The chemical reaction between NO and HNO_3 in the gas phase proceeds in the presence of NO_2 according to the reaction: $NO + NO_2 + 2HNO_3$ yields $4NO_2 + H_2O$. This reaction was examined as an additional example of the reaction involving contact ion pairs in the gas phase. The temperature dependence of this reaction was confirmed by transference of the ^{14}N atom from HNO_3 to oxides of nitrogen by the chemical reaction. Although the value of the rate constant differs from the published data, the temperature dependence exhibits a similar trend. The kinetics of the homogeneous $^{15}N/^{14}N$ exchange reaction between NO and NOCl, and NO_2 and NOCl was studied over a temperature range of 0 to 23°C. (JGB)

19706 ISOTOPIC ENRICHMENT OF CADMIUM DURING PULSED ELECTROTRANSFER AND ZONE REFINING. Troitskii, O. A.; Spitsyn, V. I.; Shcheredin, V. P. (Inst. of Physical Chemistry, Moscow). Dokl. Phys. Chem. (Engl. Transl.); 221: No. 4-6, 384-387(Apr 1975).

Translated from Dokl. Akad. Nauk SSSR; 221: No. 5, 1132-1135 (Apr 1975).

The feasibility of the isotopic enrichment of Cd by the combination of electrotransfer and zone refining was investigated. The dependence of the effect on the frequency and polarity of the current was studied. Enrichment in isotopes with m/e = 112, 114, and 116 and depletion in isotopes with m/e = 111 and 113 were clearly observed at the end of the wire where the zone had moved after the combined operation. No conclusions could be drawn about the isotopes with m/e = 106 and 108. A marked frequency and polarity effect was observed. The mechanisms responsible for the results obtained are discussed. (JSR)

Feed Materials Processing

19707 BENEFICIATION OF LOW-GRADE URANIUM ORES. Anderson, R. N. (Stanford Univ., CA); Urbanek, R. J. Trans. Am. Nucl. Soc.; 22: 318(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Radiation Chemistry

Refer also to abstracts 19770 and 22676.

19708 (COO-3118-10) EFFECTS OF MERCAPTANS AND DISULFIDES ON PHOTOCHEMICAL AND HIGH ENERGY RADIATION INDUCED REACTIONS. Progress Report, November 1, 1974–October 31, 1975. Cohen, S. G. (Brandeis Univ., Waltham, Mass. (USA)). Oct 1975. Contract E(11-1)-3118. 10p. Dep. NTIS $3.50.

A chain reaction may be formulated at alkaline pH in terms of e$^-$/sub aq/ acting as a source of $^-$OH as a reactant and H· regenerating e$^-$/sub aq/. This may account for radiolytic conversion of CO to formate with high G. ^{60}Co gamma-radiolysis of alkaline aqueous acetonitrile and acetamide gave no evidence of a chain; extensive hydrolysis of methyl acetate is now attributed to non-radiolytic, normal hydrolysis. Aromatic mercaptans are found to retard photoreduction of a benzophenone by aliphatic amines, largely by hydrogen atom-transfer repair reactions. Aliphatic mercaptans accelerate photoreduction, apparently by affecting the reduction to quenching ratio in the intermediate charge-transfer complex. In photoreduction of a benzophenone by 2,3-butylene glycol at pH 3, the glycol is converted, not to 3-hydroxy-2-butanone, but to 2-butanone, and about 4 molecules of this are formed per molecule of ketone reduced. A short chain appears to be established. Mercaptan appears to accelerate the reduction of the ketone and retard the formation of 2-butanone. (auth)

19709 (CRN-CNPA-75-17) RADIATION DAMAGE IN SOLID BUTANE IRRADIATED BY Xe^+, Kr^+, Ar^+, Ne^+, AND He^+ IONS WITH ENERGIES BELOW 1500 eV. Cailleret, J.; Paulus, J. M. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires). 1975. 20p. Dep. NTIS (US Sales Only) $3.50.

Thick solid butane targets cooled at 77°K, containing known molar fractions of iodine, were irradiated by monoenergetic rare gas ions with energies between 10 and 1500 eV. The nature and the importance of the fragmentation of the target molecules were studied through the analysis of the formed organic iodides The G values for the overall yield of organic iodides are roughly the same for the various ions investigated and they are energy-

independent between 150 and 1500 eV. However, the mode of fragmentation depends strongly on the nature of the particles, the probability of C-C bonds rupture increasing with the LET. The neutralization energy of the incoming ions is also assumed to play a part in the radiolysis of the target. (auth)

19710 INFLUENCE OF THE NATURE OF A MATRIX ON THE REACTIVITY OF ELECTRONS IN IRRADIATED SYSTEMS. Pikaev, A. K.; Ershov, B. G.; Makarov, I. E. (Inst. of Physical Chemistry, Moscow). J. Phys. Chem.; 79: No. 26, 3025-3034(18 Dec 1975).

Experimental data on the reactivity of solvated and mobile electrons in different irradiated systems are considered and generalized. Special attention is paid to the reactivity of solvated electrons toward ions of transuranium elements in dilute and concentrated alkali and carbonate aqueous solutions, toward some compounds in alcohols and melted alkali halide salts, and to the reactivity of mobile electrons in some glassy systems. Also the results of a study of decay kinetics of F centers in alkali halide crystals at different temperatures by pulse radiolysis method are described. These data are discussed from the point of view of the influence of dielectric constant, viscosity of the medium, and other parameters on the reaction rate of solvated electrons. The problem of a tunnel mechanism of electron reactions in irradiated systems is also considered. (auth)

19711 EFFECT OF THE CHARGE OF AN ELECTRON SCAVENGER ON THE RATE OF ELECTRON TUNNELING IN GLASSES AND LIQUIDS. Pilling, M. J.; Rice, S. A. (Physical Chemistry Lab., Oxford). J. Phys. Chem.; 79: No. 26, 3035-3038(18 Dec 1975).

A theoretical model for electron reactions with ions and molecules (scavengers) in liquids and glasses was developed. To represent quantum mechanical tunneling an exponential sink term was added to Fick's second law. The reaction path was analyzed in terms of encounter pair formation and direct electron tunneling to the scavenger. Analytic expressions for the rate of these processes were obtained by using Gauss's theorem. Electron reactions in glasses are not at steady state and are strongly influenced by the electron trap depth. In liquids, electron reactions rapidly reach the steady state and the rate of reaction is enhanced compared to the predictions of the Smoluchowski theory. The effect of scavenger's charge on the rate of reaction in glasses was considered. As the dominant reaction path between electrons and scavengers is tunneling even in mobile liquids, the Debye correction to the Smoluchowski theory is too large. (auth)

19712 KINETICS STUDY OF SELECTIVE SOLVATION OF ELECTRONS IN WATER–DIMETHYL SULFOXIDE MIXTURES. Koulkes-Pujo, A. M.; Gilles, L.; Sutton, J. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. Chem.; 79: No. 26, 3038-3040(18 Dec 1975).

Dimethyl sulfoxide (DMSO) is known to solvate with difficulty anions including the electron and hence the addition of DMSC to a medium increases the anionic reaction rates. An attempt was made to study this effect in mixtures of H_2O–DMSO for specific reactions of the solvated electron using the pulse radiolysis technique. To begin with we chose different solutes among those known as good scavengers of electrons, neutral ones, N_2O, and positive and negative ionic ones (NO_3^- and H^+). The experiments were carried out with a Febetron delivering 10-nsec pulses of 1.8-MeV electrons. The rate of disappearance of the solvated electron formed by the pulse was measured by direct observation of the decay absorption at 870 or 600 nm. The ultrapure products were used as supplied except for DMSO which was distilled before use. (auth)

19713 SOLVATED ELECTRON AS REDUCING SPECIES IN THE SUBMICROSECOND FORMATION OF REACTIVE TRANSIENTS. Carbanions in Solution. Dorfman, L. M.; Bockrath, B. (Ohio State Univ., Columbus). J. Phys. Chem.; 79: No. 26, 3040(18 Dec 1975).

Carbanions were generated by dissociative attachment to organomercury compounds in tetrahydrofuran. In this way, the benzyl carbanion, $PhCH_2^-$, was formed and studied. It exhibits a uv absorption band with maximum at 362 nm. Absolute rate constants for its formation, as well as for the formation of ($PhCH_2^-$, Na^+), were determined. (JGB)

19714 DIELECTRIC CONSTANT OF LIQUID AMMONIA FROM –35 TO +50°C AND ITS INFLUENCE ON THE ASSOCIATION BETWEEN SOLVATED ELECTRONS AND CATION. Billaud, G.; Demortier, A. J. Phys. Chem.; 79: No. 26, 3053-3055(18 Dec 1975).

The dielectric constant of pure liquid ammonia was measured from –35 to +50°C. In addition previous works were reviewed so as to allow the estimation of a best value for the dielectric constant anywhere between –75 and +50°C. Anomalies had been reported in the temperature coefficient of the association between solvated electrons and cations. They are explained in the light of these new measurements. (auth)

19715 ALKALI METAL SPECIES IN LIQUID AMINES, AMMONIA, AND ETHERS. Formation by Pulse Radiolysis. Fletcher, J. W.; Seddon, W. A. (Atomic Energy of Canada, Chalk River, Ont.). J. Phys. Chem.; 79: No. 26, 3055-3064 (18 Dec 1975).

Pulsed electron radiolysis of solutions of alkali metal cations in methylamine, ethylamine, liquid ammonia, tetrahydrofuran, and diethyl ether demonstrates the formation of solvated electrons, e/sub s//sup -/, ion pairs (M^+, e/sub s//sup -/), and alkali metal anions M^-. Previous work is correlated and kinetic evidence presented for the formation of a triple ion intermediate (Na_2^+, e/sub s//sup -/) in the formation of Na^- in methylamine. Studies on the formation of Na^- in metal–ethylamine or –methylamine solutions containing trace amounts of Na^+ show a marked difference in the rate depending on the metal in excess. Evidence is presented which suggests the formation of a complex with sodium in Li, Mg, or Ca solutions, whereas in K, Cs, or Rb solutions, the reaction proceeds via the corresponding K^-, Cs^-, or Rb^- species. The spectrum of (Na^+, e sub s//sup -/) was investigated in binary mixtures of THF–ethylamine and ethylamine–ammonia. In each case, a single absorption was observed; it showed a shift in the band maximum to a wavelength intermediate to that obtained in pure solvents. The effects of ammonia on the formation of, and equilibrium between, (M^-, e/sub s//sup -/) and M^- in ethylamine are also discussed. (auth)

19716 SPECTRA OF THE SOLVATED ELECTRON COUPLED WITH METAL CATIONS. Lithium in Tetrahydrofuran. Bockrath, B.; Gavlas, J. F.; Dorfman, L. M. (Ohio State Univ., Columbus). J. Phys. Chem.; 79: No. 26, 3064(18 Dec 1975).

Some recent data are presented on the aggregation of the solvated electron with an alkali metal cation for a specific system, namely lithium in tetrahydrofuran (THF). The ion pair (Li^+, e^-/sub sol/ formed in THF exhibits an absorption band with maximum at 1180 nm. The molar extinction coefficient at the maximum is 2.3×10^4 M^{-1} cm^{-1}, which gives an oscillator strength of 0.9 for the band. Absolute rate constants for the reaction of (Li^+, e^-/sub sol/) with anthracene, biphenyl, and dibenzylmercury in THF, at 25°C, were found to be 2.65×10^{10}, 1.00×10^{10}, and 1.8×10^{10} M^{-1} sec^{-1}, respectively. (JGB)

19717 ROLE OF AB INITIO CALCULATIONS IN ELUCIDATING PROPERTIES OF HYDRATED AND AMMONIATED ELECTRONS. Newton, M. D. (Brookhaven National Lab., Upton, NY). J. Phys. Chem.; 79: No. 26, 2795-2808(18 Dec 1975).

The properties of solvated electrons are analyzed in terms of a self-consistent modified continuum model based on the techniques of ab initio molecular quantum mechanics. The model is semiclassical in spirit, employing the quantum mechanical density for the excess charge and the first solvation shell in conjunction with classical electrostatics, and is developed in a general form which can be straightforwardly applied to special cases of interest, such as the solvated mono- and dielectron complexes. The advantages and disadvantages of the technique are discussed in relation to other more empirical approaches. Computational results are presented for excess electrons (mono- and dielectrons) in water and ammonia, and the role of long-range polarization of the medium in localizing the excess charge is analyzed. The variationally determined ground states are characterized in terms of equilibrium solvation shell geometry (appreciable cavities are implied for both water and ammonia), solvation energy, photoionization energy, and charge distribution. The finding of negative spin densities at the first solvent shell protons underscores the importance of a many electron theoretical treatment. Preliminary results for excited states are also reported. The calculated results are compared with experimental and other theoretical data, and the sensitivity of the results to various features of the model is discussed. Particular attention is paid to the number of solvent molecules required to trap the excess electron. (auth)

19718 AB-INITIO STUDIES INTO THE MECHANISMS OF FORMATION OF THE HYDRATED ELECTRON. Webster, B. (Univ., Glasgow). J. Phys. Chem.; 79: No. 26, 2809-2814(18 Dec 1975).

Events occurring between the time of thermalization of electrons generated in radiolyzed water and the appearance of the fully developed absorption spectrum of e^-/sub aq/ were studied. First, the significance of including diffuse orbitals in ab-initio calculations on solvated electrons is illustrated by reference to H^- and

the structures of the oxonium family H_3O^+, H_3O, H_3O^-. Five mechanisms proposed for the formation of e⁻/sub aq/ were then examined: (a) formation via the radical intermediate H_3O; (b) direct electron capture by a water molecule; (c) selective electron attachment, and attachment through a favorable vibrational mode of an n-mer; (d) attachment via the excited state $H_2O(^3B_1)$; (e) attachment arising from medium interactions. Finally attention is directed to the structure of the hydrated electron. (auth)

19719 THEORETICAL STUDIES ON THE COMPOSITION OF THE ABSORPTION SPECTRUM OF THE SOLVATED ELECTRON. Kestner, N. R.; Logan, J. (Louisiana State Univ., Baton Rouge). J. Phys. Chem.; 79: No. 26, 2815-2819(18 Dec 1975).

Investigations on the optical spectrum of electrons in polar fluids were extended to the study of the influence of cavity distortions, the higher excited states, and the role of the two electron cavity species. The higher excited states with l equals 1 were studied by simple models using numerical solutions of the differential equations and by solutions of the Copeland–Kestner–Jortner model (CKJ). In ammonia the second excited state is predicted to lie about 0.44 to 0.52 eV above the first, depending on the technique used. Most cavity distortions do not split the l equals 1 components. Those that do, yield only a small difference in energy of the levels. Improved calculations of the two electron cavity species are presented. That species is larger than the one electron cavity. Calculations using a screened interelectronic interaction predict a stable two electron species which becomes marginally stable when solvent effects are included. Thus none of these studies can explain the observed spectrum. A reinvestigation of the long-range electron–solvent interaction is needed. Preliminary results of such studies, using the recent work of Dogonadze et al. are included. Agreement with experimental results is greatly improved.

19720 INTERACTIONS BETWEEN SOLVATED ELECTRONS. I. Electron–Electron, Electron–Solvent, Solvent–Solvent Interactions in Ammonia. Valence Bond Approximation. Schettler, P. D. Jr.; Lepoutre, G. (Juniata Coll., Huntingdon, PA). J. Phys. Chem.; 79: No. 26, 2823-2827(18 Dec 1975).

The binary interaction between two electrons solvated in ammonia is considered by treating the electrons in the valence bond approximation with dispersion forces added. Solvent–solvent and solvent–electron interactions vary as a function of distance between the solvated electrons. These changes are considered within the continuum approximation along with the electronic interaction. A major result of this study is that the ground (singlet state) is separated from the lowest triplet state by kT at distances of separation as large as 10.5 A. The theoretical treatment is general in that it does not need to be restricted to the valence bond approach or to two electron problems. (auth)

19721 SOLVATION TIME OF THE ELECTRON IN POLAR LIQUIDS. Water and Alcohols. Chase, W. J.; Hunt, J. W. (Univ. of Toronto). J. Phys. Chem.; 79: No. 26, 2835-2845(18 Dec 1975).

The formation of e⁻/sub sol/ from its precursor, e⁻/sub t/, was investigated in the temperature range from -65 to 60°C using a stroboscopic pulse radiolysis (SPR) system. The rate of formation of e⁻/sub sol/, measured at 600 nm, and rate of decay of e⁻/sub t/, measured at 1300 nm, are the same; the rate of decay of e⁻/sub t/ is slower by as much as a factor of 2 when measured at 1050 nm. At 20°C the values of tau/sub sol/ are 10.7 ± 1, 23 ± 2, 34 ± 3, and 39 ± 5 psec for methanol, ethanol, 1-propanol, and 1-butanol, respectively. At 20°C tau/sub sol/ is estimated to be less than 3 psec for H_2O and D_2O. In all of the alcohols tested there is a good correlation between tau/sub sol/ and the dielectric relaxation time, tau_2, for rotation of the molecules over a wide range of temperatures; this suggests that intermolecular hydrogen bonding does not limit the rate of electron solvation. (auth)

19722 PULSE RADIOLYSIS STUDY OF SOLVATED ELECTRONS IN WATER–ETHANOL GLASSES AT 76K. Structure of the First Solvation Shell Around the Electron. Kevan, L. (Wayne State Univ., Detroit). J. Phys. Chem.; 79: No. 26, 2846-2848 (18 Dec 1975).

The initial spectrum of the trapped electron at less than or equal to 200 nsec in anhydrous C_2D_5OD glasses at 76°K has lambda/sub max/ approximately 1300 nm and shifts with time to a stable position near 540 nm. The presence of water in C_2D_5OD–D_2O glass causes a large increase in the visible portion and a decrease in the infrared portion of the initial spectrum, suggesting that the initial time scale for the solvation process is more rapid when a water molecule is in the first solvation shell of the electron, or that water induces specific structural arrangements of shallow trapping molecular configurations. From the effect of water on the spectra, a simple analysis indicates that there are four molecules in the average first solvation shell of the electron. (auth)

19723 SOLVATION TIME OF ELECTRONS IN LIQUID AMMONIA. Belloni, J.; Clerc, M.; Goujon, P.; Saito, E. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. Chem.; 79: No. 26, 2848-2849(18 Dec 1975).

The phenomenon of solvation of an electron depends either on the presence of preexisting positive potential wells and/or on the orientation of the surrounding molecules by the field arising from the electron's charge. An effort was made to evaluate the solvation time for an excess electron in liquid ammonia at low temperature (-50°C). (auth)

19724 PICOSECOND DYNAMICS OF LOCALIZED ELECTRONS IN METAL–AMMONIA AND METAL–METHYLAMINE SOLUTIONS. Huppert, D. (Bell Telephone Labs., Murray Hill, NJ); Rentzepis, P. M.; Struve, W. S. J. Phys. Chem.; 79: No. 26, 2850-2856 (18 Dec 1975).

Experimental studies are presented here for time and wavelength resolved optical bleaching of the 1.5-mu solvated electron absorption band in liquid ammonia by 1.06-mu single pulses of approximately 6 psec duration, and for electron localization in methylamine following photoionization of the M^- species in sodium-methylamine solutions by 530-nm picosecond pulses. Bleaching of the solvated electron band in methylamine by 1.06-mu pumping pulses was also studied. In both ammonia and methylamine solutions, the solvated electron absorption band is found to be homogeneously bleached between approximately 800 and 1100 nm, and the relaxation time of the 1.06-mu populated excited state of the localized electron is approximately 2×10^{-13} sec. The electron localization process in methylamine occurs within 5 psec of creation of the quasifree electron at temperatures between -40 and -80°C. (auth)

19725 CONTINUOUS REGISTRATION OF OPTICAL ABSORPTION SPECTRA OF PERIODICALLY PRODUCED SOLVATED ELECTRONS. Krebs, P. (Univ., Karlsruhe, Ger.). J. Phys. Chem.; 79: No. 26, 2941(18 Dec 1975).

Absorption spectra of unstable intermediates, such as solvated electrons, were usually taken point by point, recording the time-dependent light absorption after their production by a flash. The experimental arrangement for continuous recording of the spectra consists of a conventional one beam spectral photometer with a stabilized white light source, a monochromator, and a light detector. By periodic production of light absorbing intermediates such as solvated electrons, e.g., by ac uv light, a small ac signal is modulated on the light detector output which after amplification can be continuously recorded as a function of wavelength. This method allows the detection of absorption spectra when disturbances from the outside provide a signal-to-noise ratio smaller than 1. (auth)

19726 ABSORPTION SPECTRA OF EXCESS ELECTRONS IN ALKALI HALIDE SALT MELTS. Schmitt, W.; Schindewolf, U. (Univ., Karlsruhe, Ger.). J. Phys. Chem.; 79: No. 26, 2941-2942 (18 Dec 1975).

The absorption spectra of excess electrons in melts of alkali halide salts were determined by a previously reported technique. Instead of periodic uv-induced photoionization, the electrons were produced periodically by ac electrolysis on the surface of a platinum electrode. The wavelength lambda/sub max/ of maximum absorption of different salts and salt mixtures taken in the temperature intervals between 600 and 900°C is in the range between 700 and 1150 nm. The relative half-width of the spectra (half-width/peak position) is almost 1. (auth)

19727 TRAPPED ELECTRONS IN ORGANIC GLASSES. Willard, J. E. (Univ. of Wisconsin, Madison). J. Phys. Chem.; 79: No. 26, 2966-2973(18 Dec 1975).

The experimental observations dealing with trapped electrons in organic glasses which are most revealing as to the nature of the trapping process are discussed, and a model of trapping which they suggest is outlined. Data from optical and ESR spectrometry, differential thermal analysis, bleaching, decay, and scavenger studies are cited. It appears that after mobile electrons produced by gamma irradiation or photoionization of solutes are thermalized they first become stabilized in weak traps through polarization and dipole interactions and then deepen these traps by molecular orientation at rates dependent on the polarity of the matrix molecules and the temperature. The data suggest that the stabilized condition at any temperature involves a continuum of trap depths in which the electrons give optical spectra of different lambda/sub max/ which add up to give the broad observed spectrum. The energy of a photon absorbed by an electron in excess of the detrapping threshold for that electron determines whether the electron can migrate far enough to encounter a capturing entity. If the energy is too low the electron is retrapped rather than being bleached. Evidence for capture of epithermal subexcitation elec-

trons by some scavengers and on the heats of solvation of electrons and cations in organic glasses is also noted. (auth)

19728 TRAPPED ELECTRONS STUDIED THROUGH STIMULATED NEUTRALIZATION LUMINESCENCE. Bernas, A.; Grand, D.; Truong, T. B. (Laboratoire Chimie Physique, Orsay, France). J. Phys. Chem.; 79: No. 26, 2974(18 Dec 1975).

The optically induced or "stimulated" neutralization luminescence (SL) following gamma irradiation of rigid matrices can provide two types of information: (1) the emission spectrum characterizes the neutralization process, i.e., the neutralized cation or one of its dissociation fragments; (2) the excitation spectrum gives information on the nature and depths of the electron traps and occasionally on the trapped electrons e⁻/sub t/ spatial distribution. Examples of type 2 experiments performed at 77°K on crystalline or glassy polar matrices are presented and discussed. The photodetrapping threshold values were found at 2.3 eV for ethanol glasses (lambda/sub an/ 345 nm) and at 1.9 eV for crystalline H_2O or D_2O ices (lambda/sub an/ 380 nm). No detrapping threshold appears in the SL spectra recorded from gamma-irradiated alkaline ices. (auth)

19729 CAPTURE OF THE TRAPPED ELECTRON IN ALCOHOL GLASSES. Namiki, A.; Higashimura, T. (Kyoto Univ.). J. Phys. Chem.; 79: No. 26, 2975-2976(18 Dec 1975).

Scavenging of the presolvated electron was studied. In many matrices, the secondary electron is stabilized in shallow traps at first, and then it becomes solvated to deepen the potential well. Because the tunneling rate depends strongly on the height of the potential, scavenging by tunneling from the presolvated state possibly overcomes the tunneling from the solvated state even if the lifetime of the presolvated state is very short. Scavengers (benzene, fluorobenzene, chlorobenzene, bromobenzene, iodobenzene, o-chlorotoluene, o-bromotoluene, and o-dichlorobenzene) were added to alcohols (methanol, ethanol, 1-propanol, and 2-propanol) and were cooled rapidly to make clear glasses. These glasses were irradiated by gamma rays at 77°K with the dose of about 0.2 Mrad. The yield of the solvated electron was estimated from the optical density of the wavelength of the peak of the absorption spectrum. For every scavenger, the efficiencies in the 1-propanol glasses are larger than those in the ethanol glass. Solvation times and tunneling radii were calculated. (JGB)

19730 THE INFLUENCE OF CRYSTAL STRUCTURE ON RADICAL FORMATION IN X-IRRADIATED AMINO ACIDS. Shields, H.; Hamrick, P.J. Jr. (Departments of Chemistry and Physics, Wake Forest University, Winston-Salem, North Carolina 27109). J. Chem. Phys. 64: No. 1, 263-270 (1 Jan 1976).

ESR spectra from the L and DL optical isomers of thirteen amino acids have been observed after x-irradiation at 77 K. For most of the acids, spectra from the L and DL isomers are different at corresponding temperatures in a range from 77 to 250 K. These differences are attributed to differences in crystal structure, and specifically to the conformation of the amino group with respect to the adjacent carboxyl group. The temperature at which deamination occurs is described by the equation $T=13+137\ \sin^2\theta$, where θ is the dihedral angle between the C–N bond and the p_z orbital occupied by the unpaired electron. (auth)

19731 CONCERNING THE EFFECT OF AN APPLIED ELECTRIC FIELD ON THE DISSOCIATION OF ION PAIRS INTO FREE IONS. Freeman, G.R. (Chemistry Department, University of Alberta, Edmonton, Canada, T6G 2G2). J. Chem. Phys. 64: No. 2, 911-912 (15 Jan 1976).

Comments are made on the validity of assumptions made in a recent paper [A. Mozumder, J. Chem. Phys., 60, 4305 (1974)] concerning Onsager's theory of the effect of an applied field on the dissociation of ion pairs into free ions. (AIP)

19732 RESPONSE TO THE COMMENT: "CONCERNING THE EFFECT OF AN APPLIED ELECTRIC FIELD ON THE DISSOCIATION OF ION PAIRS INTO FREE IONS". Mozumder, A. (Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 64: No. 2, 912-913 (15 Jan 1976).

A reply is made to comments [G. R. Freeman, J. Chem. Phys. 64, 911 (1976)] made on a recent paper [A. Mozumder, J. Chem. Phys. 60, 4305 (1974)] concerning Onsager's theory of the effect of an applied field on the dissociation of ion pairs in the free ions. (AIP)

19733 EPR STUDY OF NO_2 AND NO_3 PRODUCED IN UREA NITRATE BY UV IRRADIATION, X-IRRADIATION, AND CONSTITUENT TRITIUM ATOM DECAY. Wood, D.E.; Lozos, G.P. (Department of Chemistry, University of Connecticut, Storrs, Connecticut 06268). J. Chem. Phys. 64: No. 2, 546-551 (15 Jan 1976).

NO_2 and NO_3 radicals have been produced by uv irradiation, x-irradiation, and constituent tritium atom decay in single crystals of urea nitrate. Two types of NO_3 and five types of NO_2 were produced, and which of these were observed depended on the type of irradiation and the temperature. At 77°K two types (two different orientations) of NO_2 were formed from tritium decay while only one of these was produced by x-irradiation. The various forms of NO_2 were found to irreversibly interconvert from one to another as the temperature increased. Different mechanisms for defect formation have been proposed to account for the different types of radicals formed by x-irradiation and tritium decay at room temperature and 77°K. The NO_3 species which resulted from any of the methods of irradiation at room temperature showed no ^{14}N hfs but did exhibit a significant interaction with five neighboring hydrogen bonded protons. Deuterium substitution caused the proton hfs to collapse into one line, thus simplifying the analysis. This NO_3 was the same one reported formed by γ-irradiation. A different type of NO_3 without proton hfs was formed when either x-irradiation or tritium substitution was used at 77°K. These two types did not interconvert. From evaluation of the spin-Hamiltonian parameters the electronic ground states for these NO_3 radicals have been elucidated. The low temperature form is found to be a π radical and the high temperature form is a σ radical. (auth)

19734 RADIATION-INDUCED GRAFTING OF HEXAFLUOROACETONE TO POLYETHYLENE. Clark, C. F.; Silverman, J. (Univ. of Maryland, College Park). Trans. Am. Nucl. Soc.; 22: 110(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19735 ALKYLATION OF ADAMANTANE BY ETHYLENE INDUCED BY GAMMA IRRADIATION. Podkhalyuzin, A. T.; Vikulin, V. V.; Vereshchinskii, I. V. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 221: No. 2, 381-383(11 Mar 1975). (In Russian).

The alkylation experiments were carried out in sealed glass tubes in the temperature interval from 270 to 390°C at a mole ratio of adamantane ($C_{10}H_{16}$) to ethylene (C_2H_4) of 5 : 1, which assures maximum yield of ethyladamantane. A large excess of adamantane was used in the initial mixture. The radiation yield (G value) of 1-ethyladamantane at 270 and 330°C is equal to 2360 and 1100 molecules respectively per 100 eV of adsorbed dose from ^{60}Co gamma rays. The ratio of the radiation and thermal alkylation W_R/W_T is 3.6 at 270°C and 1.5 at 330°C. At higher pressures, the weight yield of 1-ethyladamantane calculated on the initial adamantane is 37%. A reactor volume of 100 ml is used with 45 grams of adamantane and ethylene at an initial pressure of 35 atm. Irradiation was carried out at 330°C at a dose rate of 84 rad/s over a period of 12 hours. The product is a mixture of 1-ethyladamantane (29.9%) and 2-ethyladamantane (7.1%) for a total yield of 37% based on the initial adamantane. (SJR)

19736 STRUCTURE OF SLAG MINERALS AND OF GLASSES OF CORRESPONDING COMPOSITION. Royak, S. M.; Shkol'nik, Ya. M.; Orlov, V. V.; Orlova, L. A.; Ermakov, V. I. (Ural Scientific-Research Inst. of Ferrous Metals, Sverdlovsk, USSR). J. Appl. Chem. USSR (Engl. Transl.); 48: No. 5, 1035-1038(May 1975).

Translated from Zh. Prikl. Khim.; 48: No. 5, 986-990(May 1975).

The structures of akermanite and gehlenite were investigated by ESR spectral studies of specimens subjected to γ radiation at a dose of about 5 Mrad. ESR spectra of crystalline and glassy akermanite are given. Structural changes observed on the conversion of both minerals from the crystalline to the glassy states are discussed. (JGB)

19737 ESR STUDIES ON FUNDAMENTAL PROCESSES IN RADIATION CHEMISTRY AT LOW TEMPERATURES. II. Photobleaching of Trapped Electrons in 5 M K_2CO_3 Glasses at Temperatures 77 to 123°K. Kroh, J.; Plonka, A. (Technical Univ., Lodz, Poland). Nukleonika; 20: No. 9, 841-850(1975).

Trapped electrons produced in 5 M K_2CO_3 glasses by γ irradiation at 77°K, with or without the scavenger added, decay upon photobleaching with a broad band visible light with a negative value of the apparent activation energy. The decay of electrons produced by γ irradiation at 123°K is temperature independent under the same experimental conditions. (auth)

19738 KINETIC STUDY OF EARLY STAGES OF HETEROPHASE POLYMERIZATION OF VINYL CHLORIDE INITIATED BY RADIATION. Palma, G.; Sebastiani, L.; Tavan, M.; Carenza, M.; Brugnaro, S. (C.N.R. Padova, Italy). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 5, 1029-1048(May 1975).

The kinetics of the gamma radioinduced bulk polymerization of vinyl chloride in the early stages was determined in the temperature range of –30 to 50°C and dose rates varying from 0.6 to 17 rad/sec by the dilatometric method. Some runs of polymerization of vinyl chloride added with different percentages of tetrahydrofuran were also carried out. The results were found

to agree with those previously obtained with polymerizations carried out to high conversions. The results are discussed on the assumption of a decrease in the extent of swelling of the polymer by monomer with decreasing polymerization temperature. By comparison with the data of other precipitating polymerization systems the possibility of a generalized interpretation for the heterophase polymerization is examined. (auth)

19739 RADIATION-INDUCED HOMOLYTIC AROMATIC SUBSTITUTION. V. Effect of Metal Ions on the Hydroxylation of Toluene. Eberhardt, M. K.; Martinez, M. I. (Puerto Rico Nuclear Center, San Juan). J. Phys. Chem.; 79: No. 18, 1917-1920(1975).

The radiation-induced hydroxylation of toluene was investigated in presence of $K_2Cr_2O_7$, $K_3Fe(CN)_6$, $K_4Fe(CN)_6$, $Fe(ClO_4)_3$, $Fe(NH_4)(SO_4)_2$, $CuSO_4$, $Cu(ClO_4)_2$, and $Cu(OCOCH_3)_2$. With $K_2Cr_2O_7$, $K_3Fe(CN)_6$, and the Cu^{2+} salts high conversions of the OH radicals to cresols were obtained. In all these cases the isomer distribution obtained at the highest concentration investigated (5×10^{-2} M) was the same 49 to 52 percent ortho, 22 to 24 percent meta, and 26 to 28 percent para). With the exception of $K_3Fe(CN)_6$ the percentage of G(m-cresol) increased with increasing concentration of metal salt. The pH had a marked effect on the formation of cresols due to the competing acid-catalyzed elimination of water from the initially formed hydroxymethylcyclohexadienyl radicals to give benzyl radicals. No reduction of the hydroxymethylcyclohexadienyl radicals by $Fe(CN)_6^{4-}$ was observed. For the rate of oxidation of the hydroxymethylcyclohexadienyl radicals the following sequence was established: $Fe(CN)_6^{3-}$ greater than Cu^{2+} greater than Fe^{3+}.

19740 ION RADICALS IN CRYSTALS OF CELESTINE. Gromov, V. V.; Ivanov, L. N.; Kwan, T. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 403-406(1974).

Translated from Radiokhimiya: 16: No. 3, 404-409(1974).

In order to determine the role of impurities in the formation of radiation defects, samples of natural strontium sulfate (celestine) were investigated. Ion radicals in crystals of celestine from various deposits were investigated by the ESR and thermoluminescence methods. Both the natural thermoluminescence and that after irradiation with electrons were investigated. It was established that in all the samples there are radicals SO_4^-, SO_3^-, SO_2^-, and SO_2^+, stable at room temperature. The radiospectroscopic characteristics of these centers were determined. It was found that the presence of chemical impurities promotes the formation and stabilization of SO_2^- and SO_2^+ radicals. The thermal depths of the centers of capture, determining the stabilization of SO_4^- (~0.4 eV) and SO_3^-, SO_2^- (~0.6 eV) radicals in celestine, were determined. (JGB)

19741 EFFECTS OF GAMMA RAY IRRADIATION ON HCl OXIDES. McGinn, J. N. Cleveland; Case Western Reserve Univ. (1975). 84p. University Microfilms Order No. 75-27,940. Thesis (Ph. D.).

Silicon dioxide films grown in the presence of controlled amounts of gaseous HCl and O_2 at 1125°C were irradiated by gamma rays from a cobalt-60 gamma source, up to total dose levels of 10^8 rad (Si). The mole percentage ratios of HCl/O_2 used during the gate oxide formation were "0", 1, 4, and 6 percent, where the "0" percent oxides represented those oxides grown in pure oxygen following tube cleaning by a mixture of HCl and O_2. The effects of irradiation on these oxides as a function of the mole percentage ratios HCl/O_2 introduced during oxide formation were monitored for various gate bias and radiation dose levels. It was found that the addition of HCl gas to the oxidizing ambient alters the structure of the resulting oxide in such a way as to increase the number of hole trapping sites available during irradiation. The magnitude of the hole traps formed in the oxide increased as the mole percentage ratio HCl/O_2 increased. It was also observed that, in general, the number of radioinduced surface states increased as the mole percentage ratio HCl/O_2 increased. This is attributed primarily to the breaking of Si–H bonds that were formed during oxide formation. (Diss. Abstr. Int., B)

19742 PHOTOCHEMICAL CONVERSIONS OF RADICALS IN POLYVINYLACETATE AND VINYL ACETATE–ETHYLENE COPOLYMERS AT 77°K. Fuki, V. K.; Zin'kovskaya, O. V.; Bettger, T.; Mel'nikov, M. Ya.; Fok, N. V. (Moscow State Univ.). Dokl. Phys. Chem. (Engl. Transl.); 221: No. 4-6, 388-391(Apr 1975).

Translated from Dokl. Akad. Nauk SSSR; 221: No. 5, 1136-1139 (Apr 1975).

The photochemical conversions of radicals obtained on γ irradiation and on triphenylamine (TPhA)-sensitized photolysis of polyvinylacetate (PVA) and of vinyl acetate-ethylene copolymers were studied at 77°K. The relationship between these processes and PVA degradation was examined and a mechanism was proposed in which the degradation of PVA is related to secondary thermal reactions of radicals which take place when the sample is warmed. (JSR)

19743 EFFECT OF THE NATURE OF THE CATION ON THE YIELDS OF Cl_2^- IN THE PULSED RADIOLYSIS OF AQUEOUS ALKALI CHLORIDE SOLUTIONS. Kabakchi, S. A.; Zansokhova, A. A.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). Dokl. Phys. Chem. (Engl. Transl.); 221: No. 4-6, 360-362(Apr 1975).

Translated from Dokl. Akad. Nauk SSSR; 221: No. 5, 1107-1110 (Apr 1975).

The yields of Cl_2^- formation from the pulsed radiolysis of KCl, RbCl, and CsCl in air-saturated solutions were studied to determine the mechanism and the effect of the cation on the Cl_2^--formation. The results showed that the slope of the α lines, where α is a coefficient characterizing the efficiency of Cl_2^--formation, increases in going from K^+ to Cs^+. On this basis a mechanism is proposed in which a relatively long lived complex $[H_3O^+ \ldots OH]$ reacts with the Cl^-, followed by the reaction of the Cl with Cl^-. (JSR)

19744 KINETIC ASPECTS OF THE INITIATION OF GAS-PHASE CHAIN REACTIONS BY PULSED ELECTRON ACCELERATORS. Poluektov, V. A. (Physicochemical Inst., Obninsk, USSR). Dokl. Phys. Chem. (Engl. Transl.); 221: No. 4-6, 405-408(Apr 1975).

Translated from Dokl. Akad. Nauk SSSR; 221: No. 6, 1355-1358 (Apr 1975).

The reaction kinetics for pulsed initiation were analyzed using the reaction of the gas-phase chlorination of methane to form methyl chloride. Equations describing the rate of the chemical reaction and the frequency of the pulses at which the accelerator must operate were derived. (JSR)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 19676.

Hot-Atom Chemistry

Refer also to abstracts 19696 and 20953.

19745 (CRN-CNPA-75-10) SZILARD–CHALMERS EFFECTS IN HAFNIUM COMPLEXES. II. Contribution of the Perturbed Angular Correlation Technique. Abbe, J. C.; Marques-Netto, A. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires). 1975. 14p. Dep. NTIS (US Sales Only) $3.50.

Time differential measurements of the 133–482 keV γ–γ angular correlation of ^{181}Ta were performed in solid EDTA and CDTA hafnium complexes, either labelled or irradiated in a reactor. The informations deduced on the fate of the hot atoms are compared with data obtained through radiochemical analyses. (auth)

19746 NUCLEAR RECOIL CHEMISTRY IN GASES AND LIQUIDS. Urch, D. S. (Queen Mary Coll., London). Radiochemistry (London); 2: 1-73(1975).

The review is covered in sections entitled: experimental techniques; chemistry of univalent recoil species (tritium—including stereochemistry, formation of excited species, translation excitation, energetics and mechanisms, phase effects, isotope effects; fluorine; chlorine; iodine); recoil chemistry of Group VI elements—including oxygen, sulphur and a few references to selenium and tellurium; recoil chemistry of Group V elements—including nitrogen, phosphorus, and a few references to arsenic; recoil chemistry of Group IV elements—including carbon, silicon, germanium; applications of recoil chemistry. (UK)

19747 GROUND ELECTRONIC STATE OF SILYLENE. Zeck, O. F.; Su, Y. Y.; Gennaro, G. P.; Tang, Y. N. (Texas A and M Univ., College Station). J. Amer. Chem. Soc.; 96: No. 19, 5967-5973(18 Sep 1974).

Silylene-^{31}Si adds to 1,3-butadiene to give silacyclopent-3-ene-^{31}Si. Studies using nitric oxide as a scavenger demonstrate that the reacting silylene is present as 80 percent triplet and 20 percent singlet, while studies using neon as a moderator prove that the ground electronic state of silylene is a singlet. (auth)

19748 INTERMEDIATE FRAGMENTS IN THE REACTIONS OF RECOIL ATOMS OF PHOSPHORUS-32 IN MIXTURES OF

CCl_4-CH_3I. Gabov, N. I.; Subbotin, A. A. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 416-417(1974).

Translated from Radiokhimiya: 16: No. 3, 418-420(1974).

Dichloromethylphosphonic and chloromethylphosphonic acids were detected among the products of stabilization of phosphorus-32 recoil atoms in the binary system CCl_4-CH_3I. It was found that the precursors of these compounds are methylenephosphinidenes, which react with molecules of the system with a stripping of chlorine and hydrogen atoms. (auth)

Properties of Radioactive Materials

Refer also to abstracts 19733, 20193, 20726, and 22103.

19749 (AI-ERDA-13156) DECONTAMINATION AND DECOMMISSIONING CRITERIA FOR USE IN DESIGN OF NEW PLUTONIUM FACILITIES. Paschall, R. K. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1975. Contract AT(04-3)-701. 127p. Dep. NTIS $6.00.

Decontamination and decommissioning (D and D) criteria were assembled for use in designing new plutonium facilities. These criteria were gathered from literature searches and visits to many plutonium facilities around the country. The recommendations of reports and experienced personnel were used. Since total D and D costs can be millions of dollars, improved designs to facilitate D and D will result in considerable savings in cost and time and will help to leave the site for unrestricted future use after D and D. Finally, better design will reduce hazards and improve safety during the D and D effort. (auth)

19750 (ORO-1797-61) RESEARCH IN NUCLEAR CHEMISTRY. Progress Report, March 1, 1975-February 28, 1976. Choppin, G. R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1976. Contract AT(40-1)-1797. 23p. Dep. NTIS $3.50.

Progress is reported on studies of actinide complexes with fluoride ions. Results of studies on the complexation of trivalent lanthanides by pyruvate anions and NMR spectra of aminopolycarboxylate complexes of the lanthanide ions are reported. Measurements of the relatively fast rate of ligand exchange with tracer actinide ions were continued. (JGB)

19751 PREPARATION OF URANIUM COMPOUNDS. Mercier, H.; Jean, R. (to Pechiney Ugine Kuhlmann). US Patent 3,920,788. 18 Nov 1975. Priority Date 28 Sep 1971, France. 10p.

A method for the production of uranium compounds in a high state of purity comprises the steps of contacting a uranium-bearing material with aqueous sulfuric acid, adjusting the ratio of water and sulfuric acid in the resulting leach solution to within the range of 0.16 to 0.26 to precipitate impurities from the first leach solution, diluting a second leach solution after removal of the precipitate formed to adjust the ratio of water and sulfuric acid to within the range of 0.35 to 0.50. (auth)

19752 INTERACTIONS IN INORGANIC MOLECULAR CRYSTALS. ELECTRONIC SPECTRA OF ReF_6 PURE AND MIXED CRYSTALS. Bernstein, E.R.; Meredith, G.R. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 64: No. 1, 375-403 (1 Jan 1976).

Electronic absorption spectra of $ReF_6(5d^1)$ are obtained for the pure crystal and UF_6, MoF_6, and WF_6 mixed crystals. The observed transition arises from an intraconfigurational $t_{2g} \rightarrow t_{2g}$ promotion characterized $\Gamma_{7g} \leftarrow \Gamma_{8g}$ in O_h symmetry. The pure crystal is predicted to undergo a magnetic phase transition below ~1.5 K. Pair spectra, two-molecule transitions, the ground state Jahn-Teller effect, linewidths, and vibrational assignments are discussed. The major mechanism for pair coupling and magnetic ordering is identified as superexchange through low lying delocalized charge transfer bands. These interactions are qualitatively discussed and energy localizing and delocalizing interactions are separated. (auth)

19753 PROPERTIES AND REACTIONS OF URANIUM HEXAFLUORIDE BY ION CYCLOTRON RESONANCE SPECTROSCOPY. Beauchamp, J.L. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). J. Chem. Phys. 64: No. 2, 718-723 (15 Jan 1976).

Ion cyclotron resonance spectroscopy has been employed to investigate the formation and reactions of both positive and negative ions derived from uranium hexafluoride. Positive ion reactions are dominated by processes whereby the various UF^+_n fragments (n=1-3,5) react to form UF^+_4, and by clustering of UF^+_n (n=3-5) with UF_6. Trapped negative ion studies indicate that UF^-_6 can be generated both by electron attachment, which is unusually slow, and by electron transfer from other species, including UF^-_5, SF^-_6, and Cl^-. In addition, UF^-_7 is observed, both in UF_6 alone, and in higher abundance when fluoride donors such as SF^-_5 are present. Certain limits on the thermochemical properties of ions derived from UF_6 have been determined, and a high electron affinity is indicated for UF_6. The species UF^-_6 is especially stable and much less reactive than SF^-_6 in mixtures with acidic neutrals. The propensity of negative ions derived from UF_6 to form clusters is substantially less than observed for positive ions. (auth)

19754 X-RAY STUDIES ON $CaUF_6 \cdot H_2O$ AND $CaUF_6$ OBTAINED FROM AQUEOUS SOLUTIONS. Dembinski, W. (Inst. of Nuclear Research, Warsaw); Gorski, L. Nukleonika; 20: No. 9, 851-852 (1975).

Two new crystalline modifications of $CaUF_6$ obtained from the aqueous solutions are described. Crystal symmetry, lattice parameters and possible space groups were determined. Some data on phase transitions involved are listed. (auth)

19755 SIMULTANEOUS INHIBITION OF THYMIDINE DEGRADATION AND STIMULATION OF INCORPORATION INTO DNA BY 5-FLUORODEOXY-URIDINE. Howland, G. P.; Yette, M. L. (Oak Ridge National Lab., TN). Plant Sci. Lett.; 5: 157-162 (1975).

Cultured plant cells degrade exogenously supplied thymidine. 5-Fluorode-oxyuridine (FdUrd) can be used to inhibit this degradation while at the same time enhancing thymidine (dThd) incorporation into DNA. If ^{14}C- or ^{3}H-labeled dThd is used, the improvement in DNA labeling which results permits detection of DNA synthesis in freshly isolated protoplasts, as well as other sensitive measures of DNA metabolism in plant cells. (auth)

19756 HEAT OF SOLUTION OF ANHYDROUS URANYL NITRATE IN WATER AND CERTAIN ORGANIC SOLVENTS. Kanevskii, E. A.; Zarubin, A. I.; Rengevich, V. B.; Pavlovskaya, G. R. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 407-408 (1974).

Translated from Radiokhimiya: 16: No. 3, 410-411(1974).

The heats of solution of anhydrous uranyl nitrate in the acetonitrile, methanol, water, propanol, acetone, dioxane, ethanol, formamide, diethyl ether, dimethylformamide, and dimethyl sulfoxide were determined. An increase in the heat of solution of $UO_2(NO_3)_2$ with increasing donor number of the solvent was observed. (auth)

19757 THERMAL STABILITY OF THE TETRAHYDRATE OF DISUBSTITUTED THORIUM ARSENATE. Chernorukov, N. G.; Sibrina, G. F.; Moskvichev, E. P. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 409-410(1974).

Translated from Radiokhimiya: 16: No. 3, 412-413(1974).

The crystallographic characteristics of thorium arsenate with composition $Th(HAsO_4)_2 \cdot 4H_2O$ were determined. The thermal stability of this compound was investigated; the composition and x-ray diffraction characteristics of the products of its thermal decomposition were determined. (auth)

19758 INVESTIGATION OF THORIUM HYDROXYACETATES. II. Thermal Decomposition. Andryushin, V. G.; Kozhevnikov, P. B.; Pozharshaya, M. E.; Rybakov, K. A.; Shmidt, V. S. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 411-413(1974).

Translated from Radiokhimiya: 16: No. 3, 413-415(1974).

The thermal stability of thorium hydroxyacetates $Th(OH)_2(CH_3COO)_2 \cdot 3H_2O$, $Th(OH)_2(CH_3CO)_2 \cdot H_2O$, and $Th(OH)_3(CH_3COO) \cdot H_2O$ was investigated. A mechanism of thermal decomposition was proposed, based on an analysis of the TGA and DTA curves. It was found that with increasing content of CH_3COO^- groups in the molecule, the temperature of the beginning of exothermic decomposition of the compounds with the formation of ThO_2 decreases, while with increasing number of OH^- groups in the molecule, the temperature of the beginning of the endothermic step of decomposition, associated with the elimination of these groups, decreases. (auth)

19759 CHROMATOGRAPHIC ISOLATION OF COMPOUNDS OF HEPTAVALENT BROMINE-82. Kirin, I. S.; Gavrilov, V. V.; Isupov, V. K. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 414-415(1974).

Translated from Radiokhimiya: 16: No. 3, 416-417(1974).

The use of thin-layer and paper chromatography was studied both for the separation of trace amounts of labeled perbromates and for the determination of chemical forms of bromine-82, formed in the irradiation of crystalline perbromates with thermal neutrons. It was found that methods of ion exchange, thin-layer, and paper chromatography can be used for the isolation of compounds of heptavalent bromine. A rapid and effective separation of $^{82}BrO^-_4$ and lower valence forms of ^{82}Br was achieved. (auth)

19760 OXIDATION-REDUCTION REACTIONS OF ACTINIDE ELEMENTS. XXVII. Kinetics of Uranium(IV)-Neptunium(V) Reaction in Perchlorate Solutions. Blokhin, N. B.; Ermakov, V. A.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 356-360(1974).

Translated from Radiokhimiya: 16: No. 3, 355-360(1974).

A study was made of the kinetics of the uranium (IV)–neptunium (V) reaction, which leads to a change in the structure of both reagent cations. Standard thermodynamic parameters of activation were determined. The character of the observed relation of the rate of the uranium (IV)–neptunium (V) reaction to the solution acidity and the sign of the entropy of activation indicate that this reaction is an oxidation–reduction reaction of the "electron" type. A study was also made of the kinetics and the standard thermodynamic parameters of activation for the oxidation of uranium (IV) by neptunium (IV). The character of the acidity dependence and the sign of the entropy of activation indicate that this reaction, like the reactions of the same class studied previously, is an oxidation–reduction reaction of the "hole" type. (auth)

19761 STUDY OF KINETICS OF Zn^{2+}–H^+ AND Ba^{2+}–H^+ ION EXCHANGE ON KU-2 CATIONITE IN THE INTERNAL DIFFUSION REGION BY γ-RADIOMETRY. Illarionov, V. V.; Kadis, R. L.; Musakin, A. P.; Volzhinskii, A. I.; Smirnov, N. N. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 329-332(1974).

Translated from Radiokhimiya: 16: No. 3, 325-329(1974).

A γ-radioisotope method is proposed for studying the kinetics of ion exchange in a thin layer, making it possible to eliminate possible errors in the measurement of the radioactivity of the cationite grains. An experimental study was made of the effect of the solution concentration and the grain diameter of the ion exchange resin on the kinetics of Zn^{2+}–H^+ and Ba^{2+}–H^+ exchange and Zn^{2+}–Zn^{2+} and Ba^{2+}–Ba^{2+} self-diffusion. The internal diffusion and self-diffusion coefficients and their dependence on the concentration were determined. (auth)

19762 COMPLEX FORMATION IN THE SYSTEMS URANIUM HALIDE–ALKALI METAL HALIDE ENTHALPY OF FORMATION OF ALKALI METAL CHLOROURANATES (IV). Vdovenko, V. M.; Volkov, V. A.; Suglobova, I. G. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 364-368(1974).

Translated from Radiokhimiya: 16: No. 3, 363-368(1974).

The standard enthalpies of formation of the alkali metal chlorouranates (IV) were determined by a calorimetric method. The enthalpies of formation of both the penta- and hexachlorouranates (IV) increase with an increase in the atomic number of the alkali metal. The energies of the U — Cl bonds in the penta- and hexachlorouranates (IV) of the alkali metals were calculated using the Kapustinskii–Yatsimirskii method. From the point of view of a thermochemical examination an attempt was made to explain the regular increase in the enthalpies of formation of coordination compounds of one form with an increase in the atomic number of the alkali metal. (auth)

19763 FORMS OF COMPOUNDS AND THEIR RELATIVE STABILITY IN THE SYSTEMS URANIUM TRIBROMIDE–ALKALI METAL BROMIDE. Vdovenko, V. M.; Kozhina, I. I.; Suglobova, I. G.; Chirkst, D. E. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 369-375(1974).

Translated from Radiokhimiya: 16: No. 3, 369-376(1974).

Complex formation was not observed in the UBr_3–NaBr system. In the systems UBr_3–MBr (M = K, Rb, Cs) the interaction of the components leads to the formation of compounds of two forms: M_3UBr_6 and M_2UBr_5. Compounds with the form M_3UBr_6 decompose in the solid phase on cooling. Rb_3UBr_6 and Cs_3UBr_6 have a cubic structure of the type $J2_1$. In the UBr_3–CsBr system another compound is formed whose composition is described by the approximate formula $CsBr \cdot (1.7 \pm 0.1)UBr_3$. The crystal lattice of the compound is face-centered cubic. With an increase in the atomic number of the alkali metal the thermal stability increases with compounds of the form M_3UBr_6 and falls with compounds of the form M_2UBr_5. This change in thermal stability leads to "competition" of these forms of compound. An analogous "competition" occurs in the systems uranium (or plutonium) trichloride–alkali metal chloride. (auth)

19764 PREPARATION OF CYCLOTRON TARGETS FROM TRANSPLUTONIUM AND RARE-EARTH ELEMENTS BY ELECTRODEPOSITION FROM ISOBUTANOL. Korotkin, Yu. S. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 376-381(1974).

Translated from Radiokhimiya: 16: No. 3, 377-382(1974).

A study was made of the electrodeposition of transplutonium and rare-earth elements from isobutyl alcohol onto various backings. Addition of small amounts of ethyl alcohol suppresses the gas evolution process in the electrodeposition of transplutonium and rare earth elements from isobutyl alcohol and this makes it possible to obtain uniform layers. Optimal conditions were determined for obtaining thick (up to 2 mg/cm^2) cyclotron targets from these elements, which are stable under irradiation with accelerated multicharged ions. (auth)

19765 STUDY OF THE INTERACTION OF AMERICIUM WITH AMINO ACIDS. Rogozina, E. M.; Konkina, L. F.; Popov, D. K. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 382-385 (1974).

Translated from Radiokhimiya: 16: No. 3, 383-386(1974).

The complex formation of Am^{3+} with amino acids in the region of amino acid concentrations $1 \cdot 10^{-4}$–$1 \cdot 10^{-3}$ M was studied. It was found that in complex-forming ability with respect to trivalent americium, the amino acids can be arranged in the following series: glutamic acid > aspartic acid > histidine > methionine > tryptophan > serine > cysteine > glycine > phenylalanine > alanine > arginine. At ratios of the concentrations of americium ions and amino acids close to those in the living organism, the formation of complexes with a 1:1 composition is the most probable. (JGB)

19766 COMPOUND OF TETRAVALENT URANIUM WITH DIETHYLENETRIAMINEPENTAACETIC ACID. Petrzhak, G. I.; Lozhkina, G. S.; Zelentsov, S. S. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 386-389(1974).

Translated from Radiokhimiya: 16: No. 3, 386-390(1974).

A complex of uranium (IV) with diethylenetriaminepentaacetic acid with the composition $(NH_4)_6[UX_2] \cdot 4H_2O$ was synthesized for the first time. Certain chemical and physicochemical properties of the compound were studied. The ir spectra were recorded and identified, the temperature of decomposition of the compound was determined, and the behavior of the complex toward organic solvents was studied. A hypothesis was advanced on the possible structure of the isolated complex compound, in which the bond of uranium (IV) to the ligand is accomplished both through the oxygen atoms and through the nitrogen atoms. (auth)

19767 INVESTIGATION OF THORIUM HYDROXYACETATES. I. Isolation of Thorium Hydroxyacetates from Nitric–Acetic Acid Solutions by Neutralization with Ammonia. Shmidt, V. S.; Andryushin, V. G.; Rybakov, K. A.; Teterin, E. G. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 390-395(1974).

Translated from Radiokhimiya: 16: No. 3, 391-397(1974).

It was found that in the neutralization of nitric acid–acetic acid solutions containing thorium with ammonia, basic acetates with the compositions $Th(OH)_2(CH_3COO)_2 \cdot 3H_2O$, $Th(OH)_2(CH_2COO)_2 \cdot H_2O$, and $TH(OH)_3(CH_3COO) \cdot H_2O$ are isolated. The density of crystals of these compounds increases with increasing number of OH groups in their molecules. The solubility of thorium in the system at first decreases when ammonia is added, as a result of the liberation of basic salts (hydroxoacetates), but at pH = 6 to 7 it increases substantially, probably in connection with the formation of the soluble complex $(NH_4)_2Th(CH_3COO)_6$. When ammonia is further added, the solubility of thorium again decreases substantially in connection with the precipitation of a basic salt with the composition $Th(OH)_3(CH_3COO) \cdot H_2O$. The ir spectra of the isolated compounds, as well as the neutral salt $Th(CH_3COO)_4$ and the double salt $(NH_4)_2Th(CH_3COO)_6$, were investigated. An interpretation of the observed frequencies and their shifts in the case of a change in the composition of acetate compounds of thorium was performed. (auth)

19768 VAPOR TENSION OF POLONIUM AND LEAD POLONIDE. Abakumov, A. S.; Ershova, Z. V. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 396-399(1974).

Translated from Radiokhimiya: 16: No. 3, 397-401(1974).

A method of determination of the vapor pressure based on the remote measurement of a radioactive element in a known volume according to its own radiation during a dynamic equilibrium within a closed evacuated ampoule was perfected. The temperature dependence of the vapor tension of polonium is expressed by the equation $\log P_{mm} = 7.3320 \pm 0.0500$ to $5440 \pm 60/T$ (at 368 to 604°); the boiling point of polonium is 949°, the enthalpy of evaporation 24.9 ± 0.27 kcal/mole. When polonium contains more than 3% radiogenic lead, the vapor pressure of polonium decreases, and in this case negative deviations from the values of the vapor pressure calculated according to Raoult's law are observed. The temperature dependence of the vapor tension of lead polonide is expressed by the equation $\log P_{mm} = 6.9360 \pm 0.0700$ to $7270 \pm 80/T$ (at 640 to 850°); the boiling point of lead polonide is 1520°; enthalpy of evaporation is 33.3 ± 0.37 kcal/mole. (auth)

19769 VAPOR TENSION AND THERMAL DISSOCIATION OF POLONIUM DIOXIDE. Abakumov, A. S.; Ershova, Z. V. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 400-402(1974).

Translated from Radiokhimiya: 16: No. 3, 401-404(1974).

The temperature dependence of the vapor tension of polonium dioxide is expressed by the equation: $\log P_{mm} = 9.0040 \pm 0.1100$ to $10{,}070 \pm 150/T$ (at 700 to 835°C); enthalpy of evaporation 46 kcal/mole. An oxygen pressure of 65 torr is sufficient to suppress the thermal dissociation of polonium dioxide at the temperature 500°; at temperatures above 790°, an oxygen pressure of more

than 95 torr is necessary. The temperature dependence of the vapor tension of polonium dioxide with a simultaneous process of dissociation is expressed by the equation: log P_{mm} = 13.3510 to 13,800/T (at 700 to 840°); enthalpy of the process is 63.2 kcal/mole.

Radioactive Waste Treatment

Refer also to abstracts 20919, 20924, 22142, and 22502.

19770 (BNL-20898) FIXATION OF AQUEOUS TRITIATED WASTE IN POLYMER IMPREGNATED CONCRETE AND IN POLYACETYLENE. Colombo, P.; Neilson, R. Jr.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 21p. (CONF-750989-4). Dep. NTIS $3.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (30 Sep 1975).

Tritiated aqueous waste can be used to hydrate hydraulic cement producing a concrete that contains a network of interconnected porosity. Such a product is subject to water intrusion and subsequent tritium loss by leaching and exchange. Techniques have been developed to impregnate this porosity with styrene monomer which is then polymerized in situ, resulting in a concrete that is essentially impermeable while its strength, durability, and resistance to chemical attack are significantly improved. Tritium bulk leach rates as low as 1.68×10^{-4} g/(cm^2-day) have been measured for polymer-impregnated concrete in water. An adsorbent additive can be incorporated to increase the specific tritiated waste loading of the concrete. Depending upon the formulations, these composites incorporate 5.8 to 8.3 liters HTO per cubic foot. Tritiated aqueous waste can also be fixed in polymeric form as polyacetylene through reaction with calcium carbide to form tritiated acetylene which is subsequently polymerized. Acetylene polymerization is accomplished by either ^{60}Co gamma irradiation or thermal catalysis over cupric oxide. The tritiated polyacetylene produced can contain up to 50 atomic percent tritium and is essentially nonleachable, insoluble, thermally stable to 325°C, and chemically inert. The bulk leach rate of tritiated polyacetylene was determined to be of the order of 1.8×10^{-8} g/(cm^2-day). Radiolysis by ^{60}Co gamma irradiation results in a G value for hydrogen production of 0.15 molecules/100 eV. Tritiated polyacetylene can be incorporated as an aggregate in concrete, polymer concrete, or polymer impregnated concrete to form a monolithic solid. (auth)

19771 (CONF-750117-P2, pp 621-700) HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT. Platt, A. M.; McElroy, J. L. (Battelle–Northwest Lab., Richland, WA). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The major alternatives in waste management systems for the high-level wastes from commercial reprocessing plants are presented.

19772 (GA-A-13348) CURIUM-244/NEPTUNIUM-237 RECOVERY FROM THE BARNWELL NUCLEAR FUEL PLANT. Carney, H. C. (ed.). (General Atomic Co., San Diego, Calif. (USA)). Feb 1975. Contract AT(04-3)-167. 366p. Dep. NTIS $10.50.

Curium-244 sesquioxide is a potentially economic fuel in heat sources for radioisotope thermoelectric generators, when recovered from LWR spent fuel. This study was completed to determine curium availability and cost from a full-scale recovery, processing, and encapsulation facility at the Barnwell Nuclear Fuel Plant (BNFP) site. Similar information was obtained for by-product neptunium-237. The separation facility is designed to process all of the high-level liquid waste (HLLW) from BNFP (5 tonnes of fuel per day) after 3 years' aging, with a curium recovery fraction of at least 80 percent and minimum product purity of 97 percent. The reference process flowsheet consists of the following steps: HLLW feed clarification by centrifugation; removal of plutonium, neptunium, and uranium by solvent extraction; acid destruction by reaction with sugar; a second clarification by centrifugation; curium purification by ion exchange; and waste disposal. The plant also includes curia fabrication and encapsulation facilities, and neptunia target rod fabrication facilities. Capital costs and the economics of Cm production are discussed. Overall risks associated with this program are considered sufficiently large to preclude a recommendation for a commercial business venture at this time. (JGB)

19773 (HEDL-TME-75-102) COMMERCIAL ALPHA WASTE PROGRAM. Quarterly Progress Report, April, May, June 1975. Cooley, C. R. (Comp.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)2170. 43p. Dep. NTIS $4.00.

This is the fifth Quarterly Progress Report on the Commercial Alpha Waste Program being conducted at the Hanford Engineering Development Laboratory (HEDL) for the Division of Nuclear Fuel Cycle and Production, United States Energy Research and Development Administration. Tests of new construction materials for the acid digester, and safety tests of compounds which may be present when processing wastes are discussed. The behavior of uranium in alpha wastes when processed by acid digestion is discussed. Data are presented on the effects of solids build-up on waste digestion rates. Commercial radioactive waste accumulations at burial grounds are presented. The use of infrared heaters for processing combustible materials is discussed. (auth)

19774 (UNI-425) EVALUATION OF WEATHERED IMPREGNATED CHARCOALS FOR RETENTION OF IODINE AND METHYL IODIDE. Bennett, E. C.; Strege, D. E. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 7 Nov 1975. 37p. Dep. NTIS $4.00.

The results are reported of a study to determine the effect of weathering and aging on the efficiency of some impregnated charcoals in absorbing and retaining halogens and organic halides. The purpose is to establish the optimum charcoal for use in the N Reactor confinement system. Charcoals exposed for six months in the Zone I ventilation system showed little change in the retention efficiencies for elemental iodine, but the methyl iodide retention was severely degraded in all cases. The loss of efficiency of methyl iodide retention was attributed to the accumulation of organic pollutants. (JSR)

19775 OLD AND NEW METHODS OF RADIOACTIVE WASTE TREATMENT AND SOLIDIFICATION. Oyen, L. C. (Sargent and Lundy, Chicago). Trans. Am. Nucl. Soc.; 22: 121-122 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19776 ECONOMIC ANALYSIS OF SPENT-FUEL DISPOSITION ALTERNATIVES. Larkin, D. L. (Washington Public Power Supply System, Richland, WA). Trans. Am. Nucl. Soc.; 22: 326(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19777 DISPOSAL OF LUMPED BURNABLE POISON IN THE BABCOCK-205. Clark, R. H. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 347-348(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19778 THERMAL ANALYSIS OF A FUEL CLADDING REPOSITORY PILOT PLANT IN SALT. Claiborne, H. C. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 352(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19779 RADWASTE SOLIDIFICATION USING ASPHALT, AN OPTIMIZED WASTE MANAGEMENT CONCEPT. Baehr, W. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.); Hild, W.; Kluger, W.; Stewart, J. E. Trans. Am. Nucl. Soc.; 22: 352-353 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19780 CERAMICS FROM ION EXCHANGERS: AN APPROACH TO NUCLEAR WASTE SOLIDIFICATION. Dosch, R. G. (Sandia Labs., Albuquerque, NM). Trans. Am. Nucl. Soc.; 22: 355(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19781 CONSOLIDATION AND CHARACTERIZATION OF ION-EXCHANGE-DERIVED NUCLEAR WASTE CERAMICS. Johnstone, J. K.; Meyer, R. T. (Sandia Labs., Albuquerque, NM). Trans. Am. Nucl. Soc.; 22: 355-356(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19782 TRANSURANIC SOLID-WASTE TREATMENT STUDIES AT LOS ALAMOS. Hildner, R. A.; Borduin, L. C.; Draper, W. E.; Warner, C. L. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 759-761(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19783 NEW PROCESS CONSOLIDATES RADIOACTIVE WASTES. (Sandia Labs., Albuquerque, NM). Chem. Eng. News; 54: No. 2, 32-34(12 Jan 1976).

A process designed to handle liquid wastes from light water reactor reprocessing is described. The process employs one or more of several inorganic cation exchange materials of the hydrous oxide type that can be made in either water soluble or water insoluble forms. All of the cation exchange materials have the chemical form M'(M/sub x/O/sub y/H/sub z/)/sub n/, where M may be titanium, niobium, zirconium, or tantalum. Titanium is the preferred material at present. M' may be one of a variety of exchangeable ions, the usual one being sodium. In use, the exchange column is fed with liquid waste containing fission product ions which exchange with M' ions. A typical exchange reaction is $2NaTi_2O_5H + Sr^{+2}$ yields $Sr(Ti_2O_5H)_2 + 2Na^+$. The effluent from the titanate bed is then passed through a zeolite exchange bed, and the titanate and zeolite beds mixed and heated to temperatures above 600°C. Further consolidation is accomplished with pressure sintering. (JGB)

Radioisotope Production

Refer also to abstracts 20430 and 22678.

19784 FAST GAS THERMOCHROMATOGRAPHIC METHOD OF ISOLATING RADIOACTIVE ELEMENTS. II. Gold: Universal Target for Express Production of Radioactive Preparations of Rhenium, Osmium, Iridium, and Mercury. Bayar, B.; Votsilka, I.; Zaitseva, N. G.; Novgorodov, A. F. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 333-338(1974).

Translated from Radiokhimiya: 16: No. 3, 329-336(1974).

A study was made of the behavior of ultramicroamounts of rhenium, osmium, iridium, and mercury during their evaporation in a stream of oxygen, air, and helium from a melt of gold irradiated with 660 MeV protons and during the deposition of their volatile products in a thermochromatographic column in relation to the sublimation time and the carrier gas flow rate. It was found that the volatile oxides of these elements are deposited selectively on the walls of a quartz thermochromatographic column with a constant negative temperature gradient in order of falling temperature: Re (500 to 350°), Ir (180 to 80°), Hg (80 to 25°), Os. The mechanism of formation and the behavior of the volatile oxides of Re, Os, Ir, and Hg in the sublimation of their ultramicroamounts from molten irradiated gold and during deposition on colder surfaces of the quartz tube is discussed. On the basis of the data obtained an express gas thermochromatographic method was developed for the isolation of radioactive isotopes of rhenium, osmium, iridium, and mercury in a carrier-free state from a metallic gold target irradiated with 660 MeV protons. (auth)

19785 FAST GAS THERMOCHROMATOGRAPHIC METHODS OF ISOLATING RADIOACTIVE ELEMENTS. III. Formation and Thermochromatographic Behavior of Ultramicroamounts of Volatile Oxides and the Hydroxide of Tungsten. Bayar, B.; Votsilka, I.; Zaitseva, N. G.; Novgorodov, A. F. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 339-344(1974).

Translated from Radiokhimiya: 16: No. 3, 336-342(1974).

A study was made of the high-temperature (>1000°) sublimation and thermochromatographic behavior of ultrasmall and microamounts of tungsten in a stream of oxygen in relation to the water vapor pressure in the carrier gas, the carrier gas flow rate, and the sublimation time. The mechanism of formation and the behavior of ultramicroamounts of the volatile hydroxide of tungsten in high temperature sublimation and thermochromatographic deposition processes is discussed. On the basis of the data obtained a fast gas thermochromatographic method was developed for isolating radiochemically pure tungsten in a carrier-free state from gold and tantalum targets irradiated with high energy protons. (auth)

19786 FAST GAS THERMOCHROMATOGRAPHIC METHODS OF ISOLATING RADIOACTIVE ELEMENTS. IV. Isolation of Neutron-Deficient Isotopes of Zirconium and Niobium from a Silver Chloride Melt. Bayar, B.; Votsilka, I.; Zaitseva, N. G.; Novgorodov, A. F. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 345-351(1974).

Translated from Radiokhimiya: 16: No. 3, 343-351(1974).

The fast preparation of short-lived neutron-deficient isotopes of Zr and Nb was studied by gas thermochromatography of their most volatile compounds, namely, the chlorides, for subsequent nuclear spectroscopic investigations. On the basis of thermodynamic data a thick target of silver chloride was selected, from a melt of which at 850° ultramicroamounts of neutron-deficient isotopes of zirconium and niobium could be extracted preferentially and rapidly into the gas phase by means of a stream of hydrogen chloride. It was found that the addition of an equal volume of oxygen to the hydrogen chloride containing radioactive ultramicroamounts of Zr and Nb improves the gas thermochromatographic separation of Zr and Nb, improves their radiochemical purity, and also stabilizes their deposition zones at temperatures of 420 ± 40° and 230 ± 30°, respectively. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 20431, 20922, 22051–22053, and 22141.

19787 (ARH-ST-128A) RESEARCH AND ENGINEERING DIVISION SEMIANNUAL REPORT. KK Process Development and Technology, November 1, 1974–April 30, 1975. Fox, R. D. (ed.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-2130. 32p. Dep. NTIS $7.00.

Research and engineering activities with the goal of improving the performance of the plutonium processing and waste management programs being operated by the Atlantic Richfield Hanford Company are reported. (auth)

19788 (DOCKET-50332-56) BARNWELL NUCLEAR FUEL PLANT. License Application, FSAR, Amendment 14. (Allied-Gulf Nuclear Services, Barnwell, S. C. (USA)). Nov 1975. 156p. Dep. NTIS $6.75.

This Amendment 14 to the application for an operating license consists of Amendment 7 to the FSAR, which is principally a revision of Section 17.2, Operational Quality Assurance Program. Other miscellaneous revisions are also included, including a ruthenium flowsheet, installation of plutonium nitrate storage cell PNC-2, dissolver criticality, and meteorological data. (DLC)

19789 (DOCKET-701729-8) FUEL RECEIVING AND STORAGE STATION. Nuclear Regulatory Commission's Safety Evaluation Report. (Allied-General Nuclear Services, Barnwell, S. C. (USA)). Jan 1976. 58p. (NUREG-0009). Dep. NTIS $4.50.

The safety evaluation report covers design of structures, components, equipment, and systems; nuclear criticality safety; radiological safety; accident analysis; conduct of operations; quality assurance; common defense and security; financial qualifications; financial protection and indemnity requirements; and technical specifications. (LK)

19790 (DPSPU-75-30-13) EXPLOSION AND FIRE IN A-LINE FACILITY OF THE SAVANNAH RIVER PLANT. Burriss, W. H. Jr. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Sep 1975. Contract AT(07-2)-1. 4p. (CONF-751084-1). Dep. NTIS $3.50.

From ERDA safety conference; Batavia, Illinois, United States of America (USA) (2 Oct 1975).

During routine operations to reduce uranyl nitrate hexahydrate to uranium trioxide, an excessive amount of organic solution entered denitrator pots and ignited. Damage from the resulting explosion and fire amounted to about $300,000. No spread of contamination or serious injuries occurred. The facility has been restored to production with process modifications to prevent recurrence. (auth)

19791 (ICP-1052) FINAL SAFETY ANALYSIS REPORT FOR THE IRRADIATED FUELS STORAGE FACILITY. Bingham, G. E.; Evans, T. K. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs-Operations Office). Jan 1976. Contract E(10-1)-1375. 169p. Dep. NTIS $8.50.

A fuel storage facility has been constructed at the Idaho Chemical Processing Plant to provide safe storage for spent fuel from two commercial HTGR's, Fort St. Vrain and Peach Bottom, and from the Rover nuclear rocket program. The new facility was built as an addition to the existing fuel storage basin building to make maximum use of existing facilities and equipment. The completed facility provides dry storage for one core of Peach Bottom fuel (804 elements), 1½ cores of Fort St. Vrain fuel (2200 elements), and the irradiated fuel from the 20 reactors in the Rover program. The facility is designed to permit future expansion at a minimum cost should additional storage space for graphite-type fuels be required. A thorough study of the potential hazards associated with the Irradiated Fuels Storage Facility has been completed, indicating that the facility is capable of withstanding all credible combinations of internal accidents and pertinent natural forces, including design basis natural phenomena of a 10,000 year flood, a 175-mph tornado, or an earthquake having a bedrock acceleration of 0.33 g and an amplification factor of 1.3, without a loss of integrity or a significant release of radioactive materials. The design basis accident (DBA) postulated for the facility is a complete loss of cooling air, even though the occurrence of this situation is extremely remote, considering the availability of backup

and spare fans and emergency power. The occurrence of the DBA presents neither a radiation nor an activity release hazard. A loss of coolant has no effect upon the fuel or the facility other than resulting in a gradual and constant temperature increase of the stored fuel. The temperature increase is gradual enough that ample time (28 hours minimum) is available for corrective action before an arbitrarily imposed maximum fuel centerline temperature of 1100°F is reached. (LK)

19792 (KFK-2041) TAMARA: AN URANIUM EXTRACTION PILOT PLANT FOR DEMONSTRATION OF COMPUTERIZED PROCESS CONTROL IN REPROCESSING. Part 1. Description of Installation and Experimental Results. Baumgaertel, G.; Bier, K.; Kuhn, E.; Mache, H. R.; Radek, S. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Nov 1975. 60p. (In Germany). (WA-28/75). Dep. NTIS (US Sales Only) $4.50.

A uranium extraction pilot plant with in-line instrumentation is described. The plant was constructed in the course of the development and demonstration of a computer-based control of nuclear fuel reprocessing processes and is connected with the process computer system CALAS. Results gained up to now are presented and discussed and the future work suggested is designated. (auth)

19793 (ORNL-TM-4870) ENGINEERING DEVELOPMENT STUDIES FOR MOLTEN-SALT BREEDER REACTOR PROCESSING NO. 20. Hightower, J. R. Jr. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 50p. Dep. NTIS $5.50.

Autoresistance heating runs were made with the AHT-3 equipment for the continuous fluorinator development. Installation of all equipment was completed for the metal transfer experiment MTE-3B in which steps in the metal transfer process for removing rare-earth fission products from breeder reactor fuel salt will be studied. Samples of the salt and bismuth phases (at the three interfaces) from previously operated MTE-3 were analyzed to identify any interfacial impurities. The seventh tracer run, TSMC-7, has been completed in the mild steel contactor installed in the salt–bismuth flowthrough facility. TSMC-7 was performed after 1 mg of $^{237}U_3O_8$ and 11 mg of MgO were added to the salt in the salt feed tank. Salt and bismuth flow rates were 152 and 170 cc/min with an agitator speed of 68 rpm. Results from the flowing stream samples indicate that the salt-phase mass transfer coefficient was 0.0057 ± 0.0012 cm/s. Data from experiments performed in the water/mercury contactor were reanalyzed to determine if the apparent change in mass transfer coefficient was due to the controlling resistance to mass transfer changing from one phase to the other. For the fuel reconstitution development, equipment is described for absorbing UF_6 gas into a flowing salt stream containing UF_4 and reducing the resultant UF_5 to UF_4 by hydrogenation. 19 figures, 3 tables, 13 references. (DLC)

19794 (ORNL-tr-2999) ELECTROLYTIC TECHNIQUES IN THE PUREX PROCESS. Schmieder, H.; Baumgaertner, F.; Goldacker, H.; Hausberger, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Heisse Chemie). Translation of KFK-2082. 76p. Dep. NTIS $5.00.

A 16-stage electrolytic mixer-settler, operating without diaphragm, was constructed on the basis of investigations on corrosion rates and electrolytic mass transfer at different electrode materials. The mixer-settler casing was made of titanium. The Pu–U separation (1B-Battery) and the Pu back-extraction by electrolytic reduction (2B-Battery) were successfully tested during more than 1000 hours of operation. The mass transfer coefficients obtained for uranium proved that no fundamental difficulties should arise from the scaleup of the apparatus. Experiments with an electrolytic pulse-column showed favorable mass transfer coefficients, which are comparable to those of the tested mixer-settler. Flowcells were constructed and successfully tested on the basis of laboratory experiments concerning the anodic oxidation of plutonium between the cycles of the Purex process. (auth)

19795 DEVELOPMENT OF A CRYOGENIC ^{85}Kr RECOVERY SYSTEM. Kamiya, K. (Hitachi Ltd., Ibaraki, Japan); Yusa, H.; Kawaguchi, O.; Hoshino, C. Trans. Am. Nucl. Soc.; 22: 315(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19796 MODIFICATIONS OF THE SEPHIS COMPUTER PROGRAM FOR CALCULATIONS OF THE ACID THOREX SOLVENT EXTRACTION SYSTEM. Rainey, R. H.; Watson, S. B. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 315-317(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19797 SIMULATION FOR CONTROL SYNTHESIS OF A PLUTONIUM–URANIUM EXTRACTION COLUMN. McCutcheon, E. B. (Iowa State Univ., Ames); Burkhart, L. E.; Felt, R. E. Trans. Am. Nucl. Soc.; 22: 317(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19798 DECOMMISSIONING IN THE MATURE NUCLEAR FUEL REPROCESSING INDUSTRY. Anderson, F. H.; Slansky, C. M. (Allied Chemical Corp., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 350(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19799 ACTINIDE PROBLEM IN THE Th–U FUEL CYCLE. Wenzel, U.; Laser, M.; Merz, L. E. (Kernforschunganlage, Juelich, Ger.). Trans. Am. Nucl. Soc.; 22: 350-351(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

CONTROLLED THERMONUCLEAR RESEARCH

Plasma Confinement and Heating

19800 (EUR-CEA-FC-778) ION TEMPERATURE IN THE TFR TOKAMAK. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1975. 34p. Dep. NTIS (US Sales Only) $4.00.

Measurements of the T.F.R. plasma ion temperature over a wide range (300 eV ≤ T_i ≤ 100 eV) have shown that the ion energy balance can be explained by losses following a "plateau" dependence, the ion-ion collision frequency being increased by the presence of impurities. No observation of a "banana" like conduction loss has been found even for a 1 keV ion temperature plasma. (auth)

19801 (JAERI-M-5961) MEASUREMENT OF IMPURITY-ION LINES AND PARTICLE CONFINEMENT TIME IN TOKAMAK-PLASMAS JFT-2. Funahashi, A. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1975. 30p. Dep. NTIS (US Sales Only) $5.00.

The spectrum in a normal-incidence vacuum-ultra-violet region (500 Å to 2300 Å) and particle confinement time have been measured for plasmas in JFT-2 tokamak, under the conditions: toroidal field strength 9kG, filling hydrogen pressure 3.2×10^{-4} Torr, limiter diameter 50cm, max. plasma current 76kA, max. plasma density 1.7×10^{13} cm^{-3}, and max. electron temperature (450 to 250) eV. The time-histories and spacial distributions of hydrogen and impurity-ion spectral lines were measured with 50-cm normal incidence vuv, 100-cm and 25-cm visible spectrometers. The radial profiles of typical lines were determined by the inverse-transformation method. The OVII and CV emissions have peaks at r = (9 to 10) ± 3 cm from the liner center; the neutral atom densities are approximately 10^9 cm^{-3} and 10^{10} cm^{-3} and ionization numbers of hydrogen atoms are (5 to 10) $\times 10^{14}$ cm^{-3} sec^{-1} and about 10^{15} cm^{-3} sec^{-1} near the plasma center and the limiter, respectively. The particle confinement time is (10 to 5) msec from the density-distributions obtained by 4-mm interferometric measurement. The local diffusion coefficients D^M determined from the radial profiles of ionization number and electron density near the plasma center are $D_\perp^M \lesssim D_\perp^{PC} = m_e \nu_{ei}/e^2 B_z^2 \cdot kT_e$, or along the whole plasma cross section, $D_\perp^M \simeq$ (100 to 500) $\times D_\perp^{PS}$, where D^{PC} and D^{PS} are the Pseudo-classical and Pfirsch-Schlueter diffusion coefficients, respectively. (auth)

19802 (MATT-1173) WAVEGUIDE AND LOOP COUPLING TO FAST MHD TOROIDAL EIGENMODES. Paoloni, F. J. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 28p. Dep. NTIS $4.00.

Heating of plasmas by wave techniques requires an effective method of coupling rf energy to the plasma. In cavities the presence of weakly damped eigenmodes will enhance the loading of antennas when the wave frequency equals an eigenmode frequency. This report considers two methods of coupling to fast MHD eigenmodes in a toroidal cavity: one is by a waveguide mounted perpendicular to the vacuum vessel wall; and the other by a loop placed within the cavity. (auth)

19803 (MATT-1195) SMALL-SCALE DENSITY FLUCTUATIONS IN THE ADIABATIC TOROIDAL COMPRESSOR. Mazzucato, E. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Feb 1976. Contract E(11-1)3073. 10p. Dep. NTIS $4.00.

A new class of density fluctuations has been observed in the ATC tokamak by using spectral analysis of scattered microwaves. The observed frequency spectrum is consistent with that of drift waves with amplitudes that are maximum in the wavelength range 0.5 to 1.0 cm where finite ion Larmor radius effects are important for plasma stability. The total density fluctuation is n tilde /sub e/ greater than or equal to 5 x 10^{-3} anti n/sub e/. It is estimated that these fluctuations could account for a large fraction of the electron energy losses of the ATC discharge. (auth)

19804 (UCID-17037) STATUS OF 2XIIB PLASMA CONFINEMENT EXPERIMENTS. Coensgen, F. J.; Clauser, J. F.; Correll, D. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Feb 1976. Contract W-7405-Eng-48. 76p. Dep. NTIS $5.00.

This report describes the status of 2XIIB neutral beam injection experiments with stabilizing plasma. The stream suppresses ion-cyclotron fluctuations and permits density to 5 x 10^{13} cm^{-3}. The ion energy is 13 keV, and electron temperature reaches 140 eV. Plasma confinement increases with ion energy and n tau reaches 7 x 10^{10} $cm^{-3} \cdot s$ at 13 keV. The n tau energy scaling is consistent with electron drag and ion-ion scattering losses. Build-up on a streaming plasma in a steady-state magnetic field is described. (auth)

19805 COLLISIONAL DIFFUSION IN A TOKAMAK WITH A RESONANT HELICAL FIELD. Wakatani, M. (Japan Atomic Energy Research Inst., Tokai). Nucl. Fusion; 15: No. 5, 955-957(Oct 1975).

Convective flow is studied for a tokamak with a resonant helical magnetic field. The diffusion coefficient was found for the collisional regime. A brief theoretical discussion is given. (MOW)

19806 TRANSFER EFFICIENCY OF INTENSE NEUTRAL BEAMS. Riviere, A. C.; Sheffield, J. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 15: No. 5, 944-947(Oct 1975).

Intense energetic neutral beams are used for heating plasma in fusion experiments. It is shown that serious attenuation may occur during transfer of the beam from source to plasma. The critical region is where the beam passes through the input tube and this is immersed in the containment magnetic field of the plasma. Beam atoms are ionized in collisions with gas molecules, and these ions are deflected onto the tube walls. Further gas is released by this bombardment and this in turn adds to the beam ionization. One finds that for a given set of conditions there is a maximum beam current above which the beam power reaching the plasma decreases. Below this value the beam power which can be transmitted is set by the acceptable loss to the walls, or the required overall efficiency. Angular scattering for a beam composed only of atoms is a small effect and is neglected here. (auth)

19807 SELF-COMPRESSION OF A PLASMA COLUMN OF FINITE ELECTRICAL CONDUCTIVITY IN AN EXTERNAL AXIAL MAGNETIC FIELD. Zoler, D.; Grosu, I.; Laur, F.; Ruscanu, D.; Gazi, R. (Physical and Technical Research Center, Iasi). Nucl. Fusion; 15: No. 5, 901-908(Oct 1975).

The purpose of this paper is to study the influence of an external magnetic field on the self-compression of a plasma column of finite electrical conductivity. The effect of this axial magnetic field on interesting plasma parameters such as density, hydrodynamic velocity, and ion and electron temperatures is examined. The presence of an external magnetic field leads to higher parameter values and to faster plasma accumulation towards the column axis. A numerical double-step Lax-Wendorff scheme was used in the framework of the two-component MHD-model for a deuterium plasma. (auth)

19808 HOT-ELECTRON-PLASMA ACCUMULATION IN THE CIRCE MIRROR EXPERIMENT. Bardet, R.; Briand, P.; Dupas, L. (CEN, Grenoble, France). Nucl. Fusion; 15: No. 5, 865-873 (Oct 1975).

In the CIRCE experiment, the plasma is obtained by the trapping of a plasma injected into a magnetic bottle by electron heating at cyclotron resonance. The plasma density lies between 5 × 10^{11} cm^{-3} and 10^{12} cm^{-3}, the electron temperature is about 100 keV and the ion temperature is in the range of few hundred electron-volts. Gross instabilities are not observed. The ratio of the plasma density to the neutral-gas density inside the plasma is higher than 100. A few kilowatts of r f power at 8 GHz are sufficient to obtain these results, a fact which looks encouraging as far as the creation of a more effective fast-neutral-target plasma using the CIRCE-experiment concept is concerned. (auth)

19809 DENSITY LIMIT OF TOKAMAK EXPERIMENTS. Lehnert, B. (Royal Inst. of Tech., Stockholm). Nucl. Fusion; 15: No. 5, 793-798(Oct 1975).

Neutral gas which penetrates into a hot plasma body, of characteristic dimension L_b, average density $\bar{n}$ and temperature T, consists mainly of a slow and a fast component, of densities n_{ns}, n_{nf} and temperatures $T_{ns} \ll T$, $T_{nf} \simeq T$, respectively. These components have the penetration lengths $L_{ns} = 1/\sigma_{cs}\bar{n}$ and $L_{nf} = 1/\sigma_{cf}\bar{n}$, corresponding to the critical densities $n_{cs} = 1/\sigma_{cs}L_b$ and $n_{cf} = 1/\sigma_{cf}L_b$ where $1/\sigma_{cf} \simeq 100/\sigma_{cs} \simeq 5 \times 10^{18}$ m^{-2} for hydrogen in the range $10^6 < T < 10^7$ K. Thus, hot plasmas can be divided into the classes of permeable dilute, permeable non-dilute, and impermeable systems defined by $\bar{n} \lesssim n_{cs} \ll n_{cf}$, $n_{cs} \ll \bar{n} \lesssim n_{cf}$, and $n_{cs} \ll n_{cf} \ll \bar{n}$, respectively. (auth)

19810 PLUGGING A DECAYING CUSP PLASMA WITH A FREQUENCY FEEDBACK SYSTEM. Watari, T. (Nagoya Univ.,

Japan); Ogata, A.; Shoji, T.; Hiroe, S.; Sato, T.; Sugawara, M. Nucl. Fusion; 15: No. 5, 799-802(Oct 1975).

It is shown that the density dependence of the most favorable frequency of the rf electric field to confine a cusp plasma is consistent with that suggested by a theory taking account of collective response of a plasma. Based on this dependence, automatic tuning of the frequency to the optimum value for the decaying plasma is demonstrated using a feedback system piloted by an ion density measurement. (auth)

19811 RADIO-FREQUENCY PREFERENTIAL PLUGGING OF MULTI-ION-SPECIES PLASMA IN CUSPED MAGNETIC DEVICES. Hiroe, S.; Hidekuma, S.; Watari, T.; Shoji, T.; Sato, T.; Takayama, K. (Nagoya Univ., Japan). Nucl. Fusion; 15: No. 5, 769-774(Oct 1975).

The rf preferential plugging of multi-ion-species plasma is studied theoretically and experimentally in a magnetic-cusp plasma. In a He^+, N^+ and N_2^+ plasma He^+ is effectively plugged in, while N^+ and N_2^+ are allowed to escape freely from a container by the applied rf field. In a H^+, H_2^+ and H_3^+ plasma, all ion species are plugged in the container. These experiments can be explained by theory. (auth)

19812 CALCULATION OF THE GAIN FACTOR Q IN TWO-COMPONENT PLASMA SYSTEMS. Cordey, J. G.; Core, W. G. F.; Sheffield, J. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 15: No. 5, 755-764(Oct 1975).

Calculations of Q including the effects of velocity diffusion, finite ion temperature, electric fields and charge exchange are presented. It is found that if all charge-exchange fast ions are lost then Q is severely reduced for a neutral fraction, $n_n/n_e \gtrsim 7 \times 10^{-6}$. These losses are reduced by re-ionization of the charge-exchanged fast ions. Calculations for the case of a two-component tokamak show that the effective charge-exchange rate is typically reduced by 2.5–4 times owing to re-ionization. With allowance for this, it is found that, in a stationary system, the plasma loss rate $n\tau_p$ must be greater than 10^{12} cm^{-3} to achieve a Q greater than unity. (auth)

19813 THEORY OF CYCLOTRON HEATING IN LONG ADIABATIC TRAPS. Timofeev, A. V. (Inst. of Atomic Energy, Moscow). Fiz. Plazmy; 1: 88-110(1975). (In Russian)

The significance of random effects in cyclotron resonance interactions in a plasma in a long adiabatic trap is investigated. Heating in the absence of random activity and with intense and weak activity is analyzed, and expressions are obtained for the absorption, reflection, and transmission coefficients of cyclotron oscillations incident on a long trap. It is shown that the motion of particles under the action of cyclotron oscillation corresponds with a transformation of phase planes, the energy of each particle changes periodically with time, cyclotron oscillation in itself does not heat the plasma, and the heating rate will increase with increasing random interactions. It is concluded that with weak oscillations, a plasma is heated only if the motion of charged particles is subject to random interactions, while with strong oscillations, heating is due to phase trajectory instabilities which arise as a result of resonance overlapping. (IAA)

19814 ELECTRON CONFINEMENT IN AN ELECTROMAGNETIC TRAP. Sizonenko, V.L.; Stepanov, K.N. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 20: No. 4, 468-470 (Apr 1975).

The rate of decrease of the density and energy of plasma electrons in an electromagnetic trap due to their escape through the electrostatic potential barrier at the cathodes as a result of Coulomb collisions is determined. (auth)

19815 CYCLOTRON HEATING OF PLASMA ELECTRONS. I. Balmashnov, A.A.; Golovanivskii, K.S. (Patrice Lumumba Friendship of Nations University, Moscow). Sov. Phys.—Tech. Phys. 20: No. 4, 483-485 (Apr 1975).

The acceleration of an electron at electron cyclotron resonance is studied. It is shown that allowance for the relativistic variation of the mass of a particle changes the picture of the electron-cyclotron interaction qualitatively. The frequencies and amplitudes of the variations in the energy of the particle are found. The best conditions for pumping energy from the rf field to the particle do not occur when the resonance condition is satisfied exactly but at a frequency somewhat lower than the cyclotron frequency. A mechanism for nonlinear generation of low-frequency waves associated with the relativistic variations of the electron energy is proposed. (auth)

19816 CYCLOTRON HEATING OF PLASMA ELECTRONS. II. Balmashnov, A.A.; Golovanivskii, K.S. (Patrice Lumumba Friendship of Nations University, Moscow). Sov. Phys.—Tech. Phys. 20: No. 4, 486-488 (Apr 1975).

The interaction of a high-impedance rf field with a plasma at electron cyclotron resonance is investigated experimentally. It is shown that the classical theory of electron cyclotron resonance can be applied only for interaction times of the order of 10 Larmor periods. The relativistic theory proposed in the foregoing paper by the authors is valid at comparatively low rf powers. (auth)

19817 PLASMA HEATING FOR OBLIQUE INJECTION OF AN INTENSE ELECTRON BEAM IN A MAGNETIC FIELD. Skibenko, E.I.; Maslov, A.I.; Yuferov, V.B. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 20: No. 4, 489-490 (Apr 1975).

Heating of plasma electrons is studied in an intense beam-plasma discharge when the beam is injected at an angle to the magnetic field. The plasma is heated by the thermalization of electron cyclotron waves excited by the electron beam with an appreciable transverse energy component at the point corresponding to the upper hybrid resonance. (auth)

19818 NONSTATIONARY CONVECTION IN A FULLY IONIZED MAGNETIZED PLASMA. Abramov, L.A.; Alperovich, L.S. (Institute of Terrestrial Physics of the Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 3, 407-408 (Mar 1975).

The problem of the heating of a horizontal layer of a fully ionized plasma is examined. Criteria for convective nonstationary instability and the frequency of the marginal oscillations for large Hartmann numbers are obtained. The results can have applications for the study of sunspots. (auth)

19819 TURBULENT PUSHER BEHAVIOR. McCrory, R.L.; Morse, R.L. (Theoretical Division, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). Phys. Fluids 19: No. 1, 175-176 (Jan 1976).

Model calculations suggest that turbulence resulting from instability of laser driven ablatively imploded high aspect ratio pusher shells in which the unstable region is, in general, distinctly narrower than the shell will degrade, but not exclude, useful compression of these systems. (auth)

19820 NONLINEAR, THREE-DIMENSIONAL MAGNETOHYDRODYNAMICS OF NONCIRCULAR TOKAMAKS. Strauss, H.R. (Fusion Research Center, University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 19: No. 1, 134-140 (Jan 1976).

Rosenbluth's nonlinear, approximate tokamak equations of motion are generalized to three dimensions. The equations describe magnetohydrodynamics in the low β, incompressible, large aspect ratio limit. Conservation laws are derived and a well-known form of the energy principle is recovered from the linearized equations. The equations are solved numerically to study kink modes in tokamaks with rectangular cross section. Fixed-boundary kink modes, for which the plasma completely fills the conducting chamber, are considered. These modes, which are marginally stable to lowest order in circular tokamaks, become unstable with large growth rates, comparable to the growth rates of free boundary kink modes. The unstable modes are found using linearized, two-dimensional equations. The linear results are used as initial values in the nonlinear, three-dimensional computations. The nonlinear results show that the magnetic field is perturbed only slightly, while a large amount of plasma convection takes place carrying plasma from the center of the chamber to the walls. (auth)

19821 THEORY OF PARAMETRIC HEATING OF PLASMA IN THE LOWER HYBRID FREQUENCY RANGE. Rogister, A.; Hasselberg, G. (Institut für Plasmaphysik der Kernforschungsanlage Jülich GmbH, Association Euratom-KFA, 517 Jülich, Federal Republic of Germany). Phys. Fluids 19: No. 1, 108-125 (Jan 1976).

Lower hybrid turbulence can be driven parametrically by a whistler pump wave. Destabilization occurring through the resonant interaction of the whistler, an electrostatic mode, and a particle, either electron or ion, which mechanism is akin to the well-known phenomenon of inverse nonlinear Landau damping, is considered. A nonlinear theory of turbulence is developed for a range of parameters characteristic of tokamaks on the basis of the wave kinetic equation for weakly turbulent plasma in a uniform magnetic field. This yields an estimate of the saturation level of the turbulence which is, in turn, responsible for the anomalous absorption of the pump wave electromagnetic energy. Both the anomalous absorption rate and the plasma heating rate are evaluated. The theoretical results are very promising: lower hybrid parametric heating should be realizable up to densities typically of order 3×10^{14} cm^{-3} (for larger densities, the poor tunneling of the pump wave through the evanescent region between the launching structure and the turning point leads to too high electric fields in the waveguide). A decisive advantage of this form of ratio frequency heating is that energy can also be deposited directly in the ion component. (auth)

19822 STEADY-STATE THERMONUCLEAR POWER GENERATION IN A TWO-ENERGY-COMPONENT ASTRON DEVICE. Chu, K. R. (Science Applications, Inc., McLean, VA.); Kapetanakos, C. A. Nucl. Fusion; 15: No. 5, 947-951(Oct 1975).

Studies are reported on a steady-state two-component Astron

device. The basic idea is to confine a tritium plasma in a field-reversing deuterium ion layer and generate thermonuclear power from the optimized layer-plasma fusion reactions. The system is maintained at a steady state by the injection of neutral deuterium beams (150-300 keV). D-layer equilibrium and the power balance and power gain are discussed. (MOW)

19823 OPTICAL INJECTION OF BEAMS IN A MIRROR WELL. Hall, L. S.; Hooper, E. B. Jr.; Newcomb, W. A. (Univ. of California, Livermore). Nucl. Fusion; 15: No. 5, 875-889(Oct 1975).

An anisotropic, finite-beta plasma trapped in a mirror well is subject to local hydromagnetic instabilities that depend strongly upon the shape of the angular distribution function of the contained particles. Moreover, the angular distribution is a solution of a diffusion equation that can be significantly modified by appropriate changes in the relative positions and amplitudes of injected beams used to create or maintain the plasma. The question of how to inject beams so that the greatest overall pressure is maintained without the plasma becoming unstable and without inordinate demands upon the technology of beam injection is an application of the theory of continuous games. This problem and the optimal strategies for a number of games of interest are determined and described. (auth)

19824 PHYSICS OF A WALL-CONFINED FUSION SYSTEM. Gross, R. A. (Columbia Univ., New York). Nucl. Fusion; 15: No. 5, 729-735(Oct 1975).

To understand plasma phenomena which will occur in a wall-confined, shock-heated fusion system, experiments and computer simulations have been carried out. The thermonuclear fusion cycle, energy transfer from a beta greater than 1 hot plasma to a wall, plasma confinement by means of walls and a magnetic dam, and some new strong shock wave physics results are described and reviewed. (auth)

19825 FAST-WAVE HEATING OF A TWO-COMPONENT PLASMA. Stix, T. H. (Princeton Univ., NJ). Nucl. Fusion; 15: No. 5, 737-754(Oct 1975).

The use of the compressional hydromagnetic mode (also called the magnetosonic or, simply, the fast wave) is examined in some detail with respect to the heating of a tritium plasma containing a few percent deuterium. Efficient absorption of wave energy by the deuteron component is found when omega equals omega/sub c/ (deuterons), with Q/sub wave/ greater than or equal to 100. Reasonable efficiencies are found also for electron heating, but coherence effects between transit-time and Landau damping for electrons reduce the total absorption for both processes to one-half of the transit-time power, calculated separately. The fusion output of a two-component neutral-injected plasma can be enhanced by selective heating of the injected deuterons. Also, selective deuteron absorption may be used for ion-tail creation by radiofrequency excitation alone, as an alternative to neutral injection. The dominant behaviour of the high-energy deuteron distribution function is found to be f(v) approximately exp [(3/2) integral/sup v/ dv[DELTA v]/[(DELTA v/sub perpendicular/)^2]], where [DELTA v] is the Chandrasekhar-Spitzer drag coefficient, and [(DELTA v/sub perpendicular/)^2] is the Kennel-Engelmann quasi-linear diffusion coefficient for wave-particle interaction at the deuteron cyclotron frequency. An analytic solution to the one-dimensional Fokker-Planck equation, with r.f.-induced diffusion, is developed, and using this solution together with Duane's fit to the D-T fusion cross-section, it is found that the nuclear-fusion power output from an r.f.-produced two-component plasma can significantly exceed the incremental (radiofrequency) power input. (auth)

19826 POTENTIAL OF DRIVEN TOKAMAKS AS THERMONUCLEAR REACTORS. Conn, R. W.; Kesner, J. (Univ. of Wisconsin, Madison). Nucl. Fusion; 15: No. 5, 775-783(Oct 1975).

Unignited, and therefore externally driven, tokamak plasmas can be the core for economic tokamak power reactors over a significant range of machine sizes where the plasma amplification factor Q exceeds 15. In such driven systems, high-Z impurity levels from 2 to 4 times that in ignited plasmas can be tolerated. Large driven tokamaks with plasma currents greater than 4 MA achieve the highest Q-value by operating with a 50-50 D-T plasma using the minimum amount of injected power to maintain the plasma in energy equilibrium. Driving large tokamaks with injection can also be used to extend the reactor burn time should impurities accumulate. For smaller tokamaks, the optimum Q is obtained by injecting deuterium neutral beams at maximum power onto a pure tritium plasma and operating the device in the two-energy component mode described by Dawson, Furth, and Tenney. A natural connection between these two operating modes is thus obtained. The potential benefits of low-Z liners in tokamaks are also studied and it is found that the tolerable impurity level of a contaminant like carbon can be an order of magnitude larger than the tolerable level of impurities like Fe or Mo. (auth)

19827 PARTICLE AND ENERGY LOSS RATES IN MIRROR REACTORS. Galbraith, D. L.; Kammash, T. (Univ. of Michigan, Ann Arbor). Trans. Am. Nucl. Soc.; 22: 71-72(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19828 PLASMA HEATING METHODS. Consoli, T. Entropie; 11: No. 61, 41-54(1975). (In French).

The problem of heating a toroidally confined plasma to thermonuclear reactor ignition temperatures is stated, and several proposed solutions to it are described. The necessity for an extra heating source is demonstrated. Heating techniques reviewed comprise adiabatic magnetic compression, heating by rapid neutron beams, heating by electromagnetic waves, heating by magnetic pumping during transit time, and heating at the inferior hybrid frequency. Two experimental setups are described: PETULA, a classical Tokamak, and WEGA, a Stellarator (a toroidal device with helical coils). (STAR)

19829 ELECTRON BEAM HEATING FOR FUSION. Benford, J. (Physics International Co., San Leandro, CA). Laser Focus; 11: 45-48(Jul 1975).

It is pointed out that for the early demonstration of the feasibility of controlled nuclear fusion utilizing electron or laser beams a suitable approach might be based on the employment of a linear configuration which contains a magnetically confined plasma. Plasma-heating processes are considered along with energy-absorption mechanisms, approaches for reducing energy losses, the definition of reactor dimensions, and fusion-feasibility experiments. (STAR)

Plasma Diagnostics

Refer also to abstracts 19923 and 21072.

19830 (EUR-5370e, pp 407-409) A/D PROCESSING OF FAST, NON REPEATING LIGHT PULSE SUPERPOSED ON A RANDOM BACKGROUND. Charet, M.; Dumay, L.; Platz, P. (CEN, Fontenay-aux-Roses, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The number of photons, N, in a fast light pulse (FWHM = 15 ns) superposed on a random background (N* photons in a 100 ns interval) is measured for plasma diagnostics. Typically, $10^2 < N < 10^4$ and $N/10 < N^* < N/3$. Pulsed photomultipliers are used as fast electronic gates followed by RC-integrators, a common multiplexer, A/D converter and active digital memories. A dynamic range of 400 (typically 5-200 photoelectrons) has been achieved. The noise-equivalent photoelectron number is less than 2. (auth)

19831 (JAERI-M-6048) MULTI-CHANNEL NEUTRAL PARTICLE ENERGY ANALYZER FOR MEASURING ION TEMPERATURES IN TOKAMAK PLASMAS. Takeuchi, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1975. 18p. Dep. NTIS (US Sales Only) $4.50.

A multi-channel neutral particle energy analyzer has been constructed for reducing the time of measurement and improving the accuracy of measurement in Tokamak plasmas. It consists of a charge stripping cell, a 10-channel electrostatic energy analyzer and an ion detector. The maximum number of detected particles in the analyzer is 10^6 cps. Energy calibration of the electrostatic energy analyzer was made with an electron beam, and transmission efficiency calibration was experimented with a proton beam. The analyzer was found to properly measure the ion temperatures in Tokamak plasmas. The stripping cell efficiency for H_2 gas was also measured; the value is in agreement with that calculated from the charge-stripping and charge-exchange cross sections. (auth)

19832 (UCRL-77068) ENERGY ABSORPTION BY LASER FUSION TARGETS DETERMINED BY ION CALORIMETRY. Rupert, V. C.; Gunn, S. R.; Holzrichter, J. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Oct 1976. 34p. (CONF-751130-23). Dep. NTIS $4.00.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

The absorbed energy determined by the ion calorimeters was used as a basis for computations of the target behavior. Both neutron yield and x-ray spectra thus obtained were in agreement with the measured values within the precision of both calculations and experiments. Some results are described. (MOW)

19833 (UCRL-77075(Rev.1)) COMPUTER ANALYSIS OF FOUR CHANNEL X-RAY MICROSCOPY IMAGES TO OBTAIN SOURCE AND SPECTRAL EMISSION DATA ON LASER FUSION

TARGETS. Harper, T. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Dec 1975. Contract W-7405-Eng-48. 28p. (CONF-751130-15). Dep. NTIS $4.00.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A description is given of how a typical four channel microscope experiment is recorded and processed. The computer code MISE is described. Seventeen figures showing various results are given. (MOW)

19834 (UCRL-77082) X-RAY MICROSCOPY OF LASER FUSION TARGETS IN FOUR ENERGY BANDS FROM 0.7 TO 4.0 keV. Boyle, M. J.; Seward, F. D.; Harper, T. L.; Koppel, L. N.; Pettipiece, K. J.; Ahlstrom, H. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 19p. (CONF-751130-22). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A grazing x-ray microscope was shown to be able to photograph the x-ray emission from laser-produced plasmas between 0.8 and 4.0 keV with a spatial resolution of approximately 3 microns. The calibration of the x-ray mirror energy response functions and the x-ray film allow absolute measurements of the spatial and spectral distribution of the x-ray emission from laser fusion targets. (MOW)

19835 INVESTIGATION OF TWO-DIMENSIONAL PLASMA MOTIONS IN THE VICINITY OF A NEUTRAL CURRENT SHEET. Bogdanov, S. Yu.; Tokarevskaia, N. P.; Frank, A. G.; Khodzhaev, A. Z. (Physics Inst., Moscow). Fiz. Plazmy; 1: 133-146(1975). (In Russian)

Plasma drift in the vicinity of a growing current sheet is studied by microwave sounding. The experimental apparatus is described, and the dimensions of a plasma formed by θ discharge in an inhomogeneous magnetic field with a zero-force line are determined. Oscillograms are analyzed which were obtained during reflection of microwaves propagating perpendicular to the surface of the current sheet. It is shown that the plasma motion is two-dimensional and that both the plasma and the current take on the form of a sheet. It is concluded that plasma compression into a sheet occurs more quickly as the magnetic field gradient increases and as the initial gas pressure decreases. The plasma velocity along the sheet surface is found to be several times higher than that into the layer normal to its surface. The rate of plasma compression in a magnetic field with a null line exceeds the rate of self-pinching of a current in the absence of a magnetic field for equal values of current flowing in the plasma. (IAA)

19836 LOCALIZED MEASUREMENTS DURING INTENSE RELATIVISTIC ELECTRON BEAM INTERACTION WITH A COOL THETA-PINCH PLASMA. Dove, W.F.; Gerber, K.A.; Hammer, D.A. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 28: No. 4, 173-176 (15 Feb 1976).

A 1-MeV 40–80-kA 60-nsec 40-cm^2 electron beam was injected into a 3-eV 2×10^{15}-cm^{-3}-density plasma. Plasma density and temperature within the beam channel were measured by Thomson scattering, and local time-dependent magnetic probe measurements were made across a plasma diameter. The observed plasma heating rate was an order of magnitude larger than can be explained on the basis of classical collisional processes. (auth)

19837 PROBE THEORY FOR ARBITRARY SHAPE IN A LARGE DEBYE LENGTH, STATIONARY PLASMA. Chang, J.; Laframboise, J.G. (Groupe de Recherches Ionosphériques, 45 Orleans-La Source, France). Phys. Fluids 19: No. 1, 25-31 (Jan 1976).

The exact analytic current-voltage characteristic recently obtained by Fendell and by Chapkis and Baum for spherical probes in the continuum Laplace limit, is shown to be valid for arbitrary probe shape. This result has important diagnostic implications. The form of the characteristic suggests a basic modification to the usual "retarding potential" technique, in which the retarded current *divided by probe potential* is graphed logarithmically to measure electron temperature. An approximate extension to finite mean free paths is made. This leads to a prediction that a long cylindrical probe will be much more sensitive to departures from collisionless conditions than a sphere of equal diameter. Another extension of the theory includes negative ion current. The effects of departure from Laplace conditions are investigated by presenting self-consistent numerical calculations for spherical probes. Formulas for triple-probe use are presented. A widespread misuse of the Druyvesteyn method is critically examined. (auth)

19838 PULSED-GAS-VALVE MEASUREMENTS OF IMPURITY ION CONCENTRATIONS AND ENERGIES IN THE 2XII MIRROR DEVICE. Simonen, T. C.; Coensgen, F. H.; Cummins, W. F.; Molvik, A. W.; Nexsen, W. E. Jr. (Univ. of California, Livermore). Nucl. Fusion; 15: No. 5, 813-818(Oct 1975).

Measurements of impurity ion concentrations and energy distributions in the 2XII mirror device are described. The measurements were made using a fast-pulsed gas valve and a charge-exchange analyzer that employs both electrostatic and magnetic separation to obtain energy spectra of separate particle species. The predominant high-Z material detected was carbon, having a concentration of approximately 2 percent and a mean energy of 3-6 keV. Smaller amounts of oxygen were the only material other than hydrogen detected. These energetic impurity levels are determined to be contained against self-scattering into the mirror loss cones and to have only minor influences on plasma life-time and on mean ion and electron energy. (auth)

19839 NANOSECOND X-RAY PICTURES RECORDED WITH A PULSED CHANNEL PLATE. Nahrath, B.; Shakhatre, M.; Decker, G. (Institut für Plasmaforschung der Universität Stuttgart, 7 Stuttgart 80, West Germany). Rev. Sci. Instrum. 47: No. 1, 88-89 (Jan 1976).

A channel plate phosphor system has been electrically pulsed in order to obtain time and space resolved images of a fast varying x-ray source. Effective exposure times of about 3 nsec have been realized. Plasma focus x-ray pictures obtained by this method are presented. (auth)

19840 CALCULATING THE SPECTRUM OF A HYDROGEN PLASMA NEAR THE BOUNDARY OF THE SERIES. Gurovich, V. Ts.; Merenkova, L. K.; Engel'sht, V. S. (Inst. of Physics and Mathematics, Frunze, USSR). Dokl. Akad. Nauk SSSR; 221: No. 2, 315-318(11 Mar 1975). (In Russian)

For certain problems in the diagnostics of a hydrogen plasma (determining the temperature and concentration of charged particles) it is necessary to calculate the radiation spectrum near the observed boundary of the system. This study presents a technique for successively estimating the statistical microfield of the plasma in the formation of the line contour, the weakening of the line intensity as a result of ionization and the appearance of a recombination continuum associated with the attenuation of line intensity. Results of calculating the spectrum of a hydrogen plasma with $T = 16250°K$ and $n_e = 1.67\times10^{17}$ cm^{-3} are compared with experimental data and found to be in good agreement. (SJR)

19841 HIGH SPEED PHOTOGRAPHY. Proceedings of the Eleventh International Congress on High Speed Photography Held in London, England, 15–21 September 1974. Rolls, P. J. (ed.). London; Chapman and Hall (1975). 638p. (CONF-740915-).

From 11th international congress on high speed photography; London, UK (15 Sep 1974).

One hundred and four papers were presented or supplied: as well as four invited papers, there were sessions on: high-speed and ultra high-speed cameras; electro-optical cameras and shutters; holography and interferometry; holography and analysis; schlieren, shadowgraph, microscopy, stereoscopy and time-resolved spectroscopy; data reduction and image analysis; applications; terminology. One invited paper (on picosecond image converter diagnostics); seven papers on electro-optical cameras and shutters; one paper on applications (ultra-fast streak and framing technique for the observation of laser driven shock waves in transport solid targets); two late papers (on high-speed image converter x-ray studies, and on picosecond x-ray streak camera studies); and on paper supplied but not presented (on high-speed photography of a "switch-on" collisionless shock wave) were in NSA scope and separate abstracts were prepared for them. (UK)

For abstracts of individual papers see: 19842–19852.

19842 PICOSECOND IMAGE-CONVERTER DIAGNOSTICS. Schelev, M. Ya. (Lebedev Inst. of Physics, Moscow). pp 32-40 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

A brief review is presented of the improvements in picosecond image-converter diagnostics carried out since the previous Congress in 1972. The account is given under the following headings: picosecond image converter cameras for visible and x-ray radiation diagnostics; Nd: glass and ruby mode-locked laser measurements; x-ray plasma emission diagnostics; computer treatment of pictures produced by picosecond cameras. (UK)

19843 PICOSECOND CHRONOGRAPHY AT X-RAY WAVELENGTHS. Bird, P. R. (Imperial Coll. of Science and Tech., London); Bradley, D. J.; Roddie, A. G.; Sibbett, W.; Key, M. H.; Lamb, M. J.; Lewis, C. L. S. pp 118-123 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

An ultrafast streak camera for vacuum U-V to x-ray radiation is described. Preliminary measurements on laser-produced plasmas are presented with time resolution down to 150 psecs and space resolution down to 40 μm for 1 kev x-ray emission from a plasma generated by 2 GW laser pulses focussed on a Cu target.

High sensitivity and wide spectral bandwidth is due to front surface photoemission at oblique incidence. Time resolution capability of 40 psec and simultaneous spatial resolution down to a few microns is theoretically possible with this system. (auth)

19844 IMAGE-CONVERTER STREAK CAMERAS WITH VERY HIGH GAIN. pp 136-143 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975). (In French).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

A new camera is described with slit scanning and very high photonic gain (G = 5000). Development of the technology of tubes and microchannel plates has enabled direct integration of such an amplifying element in an image converter tube which does away with the couplings and the intermediary electron-photon-electron conversions of the classical converter systems having external amplification. It is thus possible to obtain equal or superior performance while retaining considerable gain for the camera, great compactness, great flexibility in use, and easy handling. (auth)

19845 APPLICATION OF ULTRA-FAST HIGH-RESOLUTION GATED-IMAGE INTENSIFIERS TO LASER FUSION STUDIES. Lieber, A. J.; Benjamin, R. F.; Sutphin, H. D.; McCall, G. H. (Los Alamos Scientific Lab., NM). pp 144-149 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

Gated-image intensifiers for fast framing have found high utility in laser-target interaction studies. X-ray pinhole camera photographs which can record asymmetries of laser-target interactions have been instrumental in further system design. High-resolution high-speed x-ray images of laser irradiated targets are formed using pinhole optics and electronically amplified by proximity focused channelplate intensifiers before being recorded on film. Spectral resolution is obtained by filtering. In these applications shutter duration is determined by source duration. Electronic gating serves to reduce background thereby enhancing signal-to-noise ratio. Cameras are used to view the self light of the interaction but may also be used for shadowgraphs. Sources for shadowgraphs may be sequenced to obtain a series of pictures with effective rates of 10^{10} frames/s. Multiple apertures have been used to obtain stereo x-ray views, yielding three dimensional information about the interactions. (auth)

19846 POCKETS CELL SHUTTER OPERATING IN THE 100 PICOSECOND RANGE. Applications to Ultra High Speed Interferometry. Blanchet, M. (Lab. Central de l'Armement, Arcueil, France); Gex, J. P. pp 150-156 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975). (In French).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

The object of the first part of the statement is the study and the description of a 20 × 20 mm section transversal field shutter realized as a line transmission structure, acting as a roller-blind shutter acting within the limits of a subnanosecond. It is constituted by two appropriately cut, deuterized KDP electro-optical crystals, situated on either side of a birefringent plate having its neutral lines at a 45° angle to their optical axis, placed within a portion of the dual plate transmission line. A resolution above 20 pairs of lines per millimetre, as well as a Transmission/Extinction ratio greater than 100 over all the optical section are obtained for a 250 picoseconds dynamic functioning. The second part of the statement deals with the application of this shutter to photography and hyper-rapid interferometry of plasmas created by lasers. (auth)

19847 ULTRA HIGH SPEED FRAMING PHOTOGRAPHS OF LASER PRODUCED PLASMAS USING A PICOSECOND OPTICAL SHUTTER. Gillman, G. B.; Ramsden, S. A. (Hull Univ., Eng.). pp 157-162 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

A study has been carried out of the spatial transmission properties of the optical Kerr effect shutter and it has been used to take ultra high speed framing photographs of laser produced plasmas in air and from solid targets. With a 1 cm long CS_2 cell of aperture 5 cm^2 a transmission of ~5% and an on/off contrast ratio of 10^4 was obtained. An image intensifier was necessary to obtain adequately exposed photographs of the plasma and the overall spatial resolution of the system was ~2μ. (auth)

19848 ULTRA FAST X-RAY STREAK CAMERA. Coleman, L. W.; McConaghy, C. F. (Univ of California, Livermore). pp 196-201 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

A unique ultrafast x-ray sensitive streak camera, with a time resolution of 50 psec, has been built and operated. A 100 Å thick gold photocathode on a beryllium vacuum window is used in a modified commercial image converter tube. The x-ray streak camera has been used in experiments to observe time resolved emission from laser-produced plasmas. (auth)

19849 ULTRAFAST STREAK AND FRAMING TECHNIQUE FOR THE OBSERVATION OF LASER DRIVEN SHOCK WAVES IN TRANSPARENT SOLID TARGETS. Van Kessel, C. G. M.; Sachsenmaier, P.; Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Munich). pp 437-441 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

Shock waves driven by laser ablation in plane transparent plexiglass and solid hydrogen targets have been observed with streak and framing techniques using a high speed image converter camera and a dye laser as a light source. The framing pictures have been made by mode locking the dye laser and using a wide streak slit. In both materials a growing hemispherical shock wave is observed with the maximum velocity at the onset of laser radiation. (auth)

19850 HIGH-SPEED IMAGE CONVERTER X-RAY STUDIES. Bryuknevitch, G. I.; Kas'yanov, Yu. S.; Korobkin, V. V.; Prolhorov, A. M.; Stepanov, B. M.; Chevokin, V. K.; Schelev, M. Ya. (Lebedev Inst. of Physics, Moscow). pp 554-560 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

Two x-ray high- speed image-converter cameras (ICC) have been developed. In the first one a soft x-ray radiation is converted into visible light with the aid of a 0.5 ns response time, plastic scintillator. The second camera incorporates a photocathode which is sensitive to visible and x-ray radiation. Its calculated temporal resolution approaches 5 to 7 ps. Both developed cameras were employed for studies of x-ray radiation emitted by laser plasma. For the smooth nanosecond excited laser pulses, a noticeable amplitude modulation was recorded in all laser pulses reflected by plasma as well as in each third pulse of x-ray plasma radiation. It was also observed that the duration of x-ray plasma radiation is 20 to 40% shorter than that of the incident nanosecond laser pulses and this duration being 3 to 6 times longer than that of the picosecond irradiating pulses. The half-width of the recorded x-ray plasma pulses was 30 to 60 ps. (auth)

19851 PICOSECOND X-RAY STREAK CAMERA STUDIES. Kasyanov, Yu. S.; Malyutin, A. A.; Richardson, M. C.; Chevokin, V. K. (Levedev Inst. of Physics, Moscow). pp 561-568 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

Some initial results of direct measurement of picosecond x-ray emission from laser-produced plasmas are presented. A PIMUMI 93 image converter tube, incorporating an x-ray sensitive photocathode, linear deflection, and three stages of image amplification was used to analyze the x-ray radiation emanating from plasmas produced from solid Ti targets by single high-intensity picosecond laser pulses. From such plasmas, the x-ray emission typically persisted for times of 60 psec. However, it is shown that this detection system should be capable of resolving x-ray phenomena of much shorter duration. (auth)

19852 HIGH-SPEED PHOTOGRAPHY OF A "SWITCH-ON" COLLISIONLESS SHOCK. El-Khalafawy, T. A.; El-Nicklawy, M. M.; Bashara, A. B.; El-Masty, M. A.; Rudnev, N. J. (Atomic Energy Commission, Cairo). pp 612-615 of High Speed Photography. Rolls, P. J. (ed.). London; Chapman and Hall (1975).

From 11th international congress on high speed photography; London, UK (15 Sep 1974). See CONF-740915-.

The paper presents the results of the investigation of a "switch-on" shock profile and the measurement of the wave velocity in the collisionless regime employing high-speed photography. Data for the electron temperature (T_e) ahead of and behind the wave front are presented here, and a table with estimated and measured characteristic physical quantites. (auth)

Plasma Kinetics (General)

19853 (CONF-750905-23) INJECTION, COMPRESSION AND STABILITY OF INTENSE ION-RINGS. Sudan, R. N. (Cornell Univ., Ithaca, N. Y. (USA)). 1975. Contract AT(11-1)-3170. 23p. Dep. NTIS $3.50.

From 7th European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

Recent advances in pulsed high power ion beam technology make

possible the creation of intense ion-rings with strong self-magnetic fields by single pulse injection. Such ion rings have several uses in controlled fusion e.g., to produce a min parallel B parallel magnetic geometry with a mirror ratio much higher than is possible with external conductors. For even stronger ion rings a min parallel B parallel with closed lines of force (ASTRON type) can be created. For this purpose, since the ion energies required are much higher than are available from high power sources, magnetic compression can be utilized to increase the ion energy. The success of this scheme depends critically on the stability of the ion ring. The low frequency perturbations of the ring-plasma system is examined by means of a generalization of the energy principle which established sufficient conditions for stability. The high-frequency micro-instabilities and their nonlinear consequences are discussed in terms of conventional techniques. (auth)

19854 (EUR-CEA-FC-777) LINE RADIATION IN THE VISIBLE AND ULTRAVIOLET IN TFR TOKAMAK PLASMAS. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1975. 67p. Dep. NTIS (US Sales Only) $4.50.

Line radiation in the visible and ultraviolet (100 to 1300 Å) spectral regions was studied on TFR for a 140 kA, 26 kG plasma. The emission is integrated along the line of sight, except for neutral deuterium visible radiation, which has been spatially resolved. From the measured absolute signals the initial (in the first ten milliseconds) amount of impurities was determined. Subsequently the observed signals can be interpreted in terms of an impurity recycling flux. It was deduced from power balance considerations that this flux is confined to an external plasma shell, a small part only diffusing towards the center to account for the independently inferred Z_{eff}. The power radiated by the observed lines corresponds to an important fraction of the injected ohmic power (~30–40%). Two lines ascribed to MoXXXI and MoXXXII (and therefore originating in the central hot plasma core) were detected for electron temperatures greater than 1.5 keV. (auth)

19855 (UCID-16992) PHOTON-INDUCED GAS BREAKDOWN IN THE GAS-EMBEDDED Z-PINCH. Eddleman, J. L.; Hartman, C. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1976. Contract W-7405-Eng-48. 20p. Dep. NTIS $4.00.

The breakdown of dense gas surrounding a thermonuclear temperature z-pinch is estimated. Restrictions on the pinch mass, driving electric field, and surrounding neutral gas density are obtained. (auth)

19856 LASER-INDUCED OPTICAL SATELLITE LINE PROFILES IN A HELIUM PLASMA. Prosnitz, D.; Wildman, D.W.; George, E.V. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. A 13: No. 2, 891-906 (Feb 1976).

We have observed several different satellite transitions among He I excited states. These satellites were induced by large, near-resonant, spatially inhomogeneous electric fields. A simple theory was proposed to explain the line shape of both the satellite and the allowed line based on the rotating-wave approximation. The plasma was contained in a dielectric waveguide and the laser mode pattern inside the guide was calculated and incorporated into the line-shape function. It was shown that excellent agreement between theory and experiment could be obtained over a wide range of experimental parameters. Agreement was very good in regimes where perturbation theory fails. We also observed that at high field strengths the Stark shift of the allowed component was less than the three-level theory predicted. We attribute this error to the fact that we have ignored all of the remaining levels of the He I system. (auth)

19857 STRONG SELF-FOCUSING DUE TO THE PONDEROMOTIVE FORCE IN PLASMAS. Max, C.E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 19: No. 1, 74-77 (Jan 1976).

Self-focusing of cylindrical beams due to the ponderomotive force behaves quite differently for the full exponential nonlinearity than for the weak, cubic-nonlinearity limit. Steady self-trapped propagation becomes possible for arbitrary incident powers. Self-focusing becomes a periodic oscillatory phenomenon, rather than a catastrophic process in which the light intensity increases without limit. (auth)

19858 HYBRID MODEL STUDIES OF ION DYNAMICS AND MAGNETIC FIELD DIFFUSION DURING PINCH IMPLOSIONS. Sgro, A.G.; Nielson, C.W. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Phys. Fluids 19: No. 1, 126-133 (Jan 1976).

A one-dimensional numerical hybrid model (Vlasov ions, fluid electrons) which includes all nontrivial field components has been devised and its predictions have been compared with experimental pinch results. The effect of microscopic electron dynamics is included on the average by the specification of (anomalous) resistivity and thermal conductivity coefficients. The model has reproduced the magnetic field profiles observed during the implosion and post implosion phases of several screw pinch experiments. The behavior of the imploding plasma as various physical parameters are changed is discussed. The foot in the front of an experimentally determined density profile of a high density theta pinch is reproduced and shown to be due to a reflected ion beam. For some conditions the formation of a reflected ion beam is found to be dependent upon whether the bias is parallel or antiparallel to the driving field. (auth)

19859 CURRENT FLOW IN A HIGH-VOLTAGE DIODE SUBJECTED TO A CROSSED MAGNETIC FIELD. Orzechowski, T.J.; Bekefi, G. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Fluids 19: No. 1, 43-51 (Jan 1976).

The space-charge limited electron current (≃50 kA) flowing in a pulsed, high voltage (~200 kV) vacuum diode is studied as a function of magnetic field applied at right angles to the diode electric field. The observations compare favorably with predictions from self-consistent theory which takes account of space-charge and allows for the presence of the magnetic field. Time-resolved measurements of the diode current and voltage lead to a determination of the expansion velocity of the cathode and anode plasmas. It is shown that a magnetic field of ~5 kG suffices to stop plasma motion, in agreement with magnetohydrodynamic computations. Thus, diode closure is inhibited, at least over the 40 nsec time span of the voltage pulse. (auth)

19860 PLASMA SCREENING EFFECT IN ION-ION SCATTERING. Peres, A.; Ron, A. (Department of Physics, Technion–Israel Institute of Technology, Haifa, Israel). Phys. Rev. A 13: No. 1, 417-425 (Jan 1976).

When a plasma is extremely dense or hot, the electrons lose their efficiency for stopping heavy charged particles. The main process for their slowing down then is the small-angle ion-ion scattering, where the bare Coulomb cross section becomes infinite as θ^{-4}. The purpose of this paper is to evaluate the collective screening effects which make the ion Coulomb cross section finite. The calculations are performed in the random-phase approximation and show that the Coulomb cross section is essentially cut off for energy transfers smaller than $\hbar\omega_p$, where ω_p is the plasma frequency of the ions. (auth)

19861 PLASMA-CATHODE INTERACTION MODEL FOR ARCS WITH SMALL CATHODE DROPS. Mitrovich, D. (Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. A 13: No. 1, 476-489 (Jan 1976).

An extention of the interaction of theory of a Langmuir probe with a plasma to the case of an electron-emitting probe surface is used in a simplified model of the cathode region of high-pressure refractory cathode arcs. The interaction determines the matching condition at the plasma-cathode interface. Such an interaction is physically reasonable when the cathode drop is small compared with the plasma ionization potential. The model, formulated to be only qualitative, is solved analytically and its behavior analyzed. The model's ability to display a wide range of arc currents over which the cathode drop is nearly constant at a few volts is demonstrated in a numerical example. (auth)

19862 PHYSICAL AND DYNAMICAL CHARACTERISTICS OF A PLASMA FLOW IN AN ELECTRIC T TUBE. Borzeix, J.; Doffin, J.; Morin, G. (Poiters Univ., France). J. Phys., D (London); 8: No. 16, 1967-1974 (11 Nov 1975).

A low-density argon plasma is studied in an electric discharge T tube. In the experimental conditions the shock wave and the contact surface merge. The wave trajectory, determined from measurements obtained by a rotating-mirror camera, is described by a similarity solution of blast waves; it enables the authors to calculate the fraction of energy transferred to the gas. The temperature and the electron density are deduced from spectroscopic measurements. (auth)

19863 OPACITITES OF HIGH TEMPERATURE URANIUM PLASMAS. Pritzker, A.; Dressler, K.; Haelg, W. (Eidgenoessische Technische Hochschule, Zurich). J. Quant. Spectrosc. Radiat. Transfer; 15: No. 12, 1131-1136 (Dec 1975).

Cross sections for thermal radiation in a uranium plasma at solid state density and temperatures in the keV range are presented. The bf- and ff-absorption of ions is described by Kramers-type formulae and scattering on electrons by the Thomson formula. The bf-contributions from different states of ionization and excitation are treated individually, using a Slater model for the mean ionization potential of each electron configuration. It is assumed that all terms of a configuration contribute to one common absorption edge, and that excited configurations give rise to hydrogen-like series. The resulting frequency-dependent cross sections are illustrated. For $kT < 10$ keV scattering is unimportant. Near the Planck maximum ($h\nu \simeq 3\,kT$), the main contributions to the overall absorption arise from the ionization of the ground configurations of the predominant ionization stages. (auth)

Plasma Kinetics (Experimental)

19864 RECOMBINATION IN THE AFTERGLOW OF XENON. Gerasimov, G.N.; Khryakov, B.V. Opt. Spectrosc. (USSR) 39: No. 3, 256-257 (Sept 1975).

The process of recombination in a decaying xenon plasma was studied experimentally at intermediate pressures. The initial electron density ranged from 10^{12} cm^{-3} to 10^{14} cm^{-3}. It is shown that the increase in recombination rate with pressure involves a dissociative mechanism. (auth)

Plasma Kinetics (Theoretical)

Refer also to abstracts 20048 and 21380.

19865 (LA-5988) SLOWING-IN DISTRIBUTION OF FAST PARTICLES RELEASED IN MAXWELLIAN PLASMA. Husseiny, A. A.; Sabri, Z. A.; Harris, D. R. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1975. Contract W-7405-Eng-36. 19p. Dep. NTIS $4.00.

The time-independent slowing-in distribution is evaluated for a fast beam of test particles released in an infinite Maxwellian plasma background for various situations including quantum-mechanical and classical scattering regimes. The analysis involves considerations of small angle deflection and large angle scattering events. The results are determined for plasma electrons with thermal velocities larger or smaller than the test particle and plasma ions with thermal velocities lower than the test particle. When plasma electrons and ions are slow the slowing-in distribution behaves as E/sub j//sup ½/, where E/sub j/ is the test particle energy. When plasma electrons are faster than the test particles, the high-energy tail acquires a 1/E/sub j/ shape. The origin of the test particle remains arbitrary and hence the results apply for particles produced by fusion events within the plasma proper and for particles externally injected. The total energy distribution is obtained and normalized, and ranges of validity are determined. The calculations are of the Boltzmann type, which is consistent with binary scattering models. The slowing-in distributions are also obtained from the Fokker–Planck equation, and as expected, the results agree with those obtained from the Boltzmann equation for large angle scattering only. (auth)

19866 (LA-6136) DESCRIPTION OF COLLISIONLESS PLASMAS BY CLASSICAL FIELD EQUATIONS. Fraley, G. S. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1975. Contract W-7405-Eng-36. 7p. Dep. NTIS $4.50.

Classical field equations are derived from quantum fields to obtain a different and possibly simpler description of a collisionless plasma. The method is to take the simultaneous limit, Dirac constant, e, m yields 0, of charged scalar fields and the electromagnetic field. Laplace transforms for perturbations in a uniform relativistic plasma are compared with corresponding results from the Maxwell–Vlasov equations. For the nonlinear case, a distribution function defined on the classical fields is shown to satisfy the Vlasov equation. (auth)

19867 (LBL-4444) MATHEMATICAL MODELS AND ALGORITHMS FOR THE COMPUTER PROGRAM 'WOLF'. Halbach, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-Eng-48. 59p. Dep. NTIS $5.50.

The computer program FLOW finds the nonrelativistic self-consistent set of two-dimensional ion trajectories and electric fields (including space charges from ions and electrons) for a given set of initial and boundary conditions for the particles and fields. The combination of FLOW with the optimization code PISA gives the program WOLF, which finds the shape of the emitter which is consistent with the plasma forming it, and in addition varies physical characteristics such as electrode position, shapes, and potentials so that some performance characteristics are optimized. The motivation for developing these programs was the desire to design optimum ion source extractor/accelerator systems in a systematic fashion. The purpose of this report is to explain and derive the mathematical models and algorithms which approximate the real physical processes. It serves primarily to document the computer programs. 10 figures. (RWR)

19868 (ORNL-TM-5237) LINEARIZED GYRO-KINETIC EQUATION. Catto, P. J.; Tsang, K. T. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 28p. Dep. NTIS $5.00.

An ordering of the linearized Fokker-Planck equation is performed in which gyroradius corrections are retained to lowest order and the radial dependence appropriate for sheared magnetic fields is treated without resorting to a WKB technique. This description is shown to be necessary to obtain the proper radial dependence when the product of the poloidal wavenumber and the gyroradius is large (k rho much greater than 1). A like particle collision operator valid for arbitrary k rho also has been derived. In addition, neoclassical, drift, finite beta (plasma pressure/magnetic pressure), and unperturbed toroidal electric field modifications are treated. (auth)

19869 (UCID-16830(Rev.1)) VOA: A 2-d PLASMA PHYSICS CODE. Eltgroth, P. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1975. Contract W-7405-Eng-48. 38p. Dep. NTIS $4.00.

A 2-dimensional relativistic plasma physics code was written and tested. The non-thermal components of the particle distribution functions are represented by expansion into moments in momentum space. These moments are computed directly from numerical equations. Currently three species are included - electrons, ions and "beam electrons". The computer code runs on either the 7600 or STAR machines at LLL. Both the physics and the operation of the code are discussed. (auth)

19870 (UCRL-52009) COUPLED MHD-MONTE CARLO TRANSPORT MODEL FOR DENSE PLASMAS. Chandler, W. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. Contract W-7405-Eng-48. 104p. Dep. NTIS $5.45.

Thesis.

A two-dimensional, two fluid model of the MHD equations has been coupled to a Monte Carlo transport model of high energy, non-Maxwellian ions. The MHD part of the model assumes complete ionization and includes a perfect gas law for a scalar pressure, a tensor artificial viscosity, electron and ion thermal conduction, electron-ion coupling, and a radiation loss term. A simple Ohm's Law is used with a B/sub theta/ magnetic field. The MHD equations were solved in Lagrangian coordinates. The conservation equations were differenced explicitly and the diffusion-type equations implicitly using the splitting technique. The Monte Carlo model solves the equation of motion for high energy ions, moving through and suffering small and large angle collisions with the fluid Maxwellian plasma. The source of high energy ions is the thermonuclear reactions of the hydrogen isotopes, or it may be an externally injected beam of neutralized ions. In addition to using the usual Maxwell averaged thermonuclear cross sections for calculating the number of reactions taking place within the Maxwellian plasma, the high energy ions may suffer collisions resulting in a reaction. In the Monte Carlo model all neutrons are assumed to escape, and all energetic ions of Z less than or equal to 2 are followed. (auth)

19871 θ PINCH IN A WEAKLY IONIZED GAS-DISCHARGE PLASMA. Vladimirov, V. V.; Gorshkov, V. N.; Yavlinskii, Yu. N. (Inst. of Physics, Kiev). Fiz. Plazmy; 1: 127-132(1975). (In Russian)

A theory is developed for the θ pinch in a gas-discharge plasma under conditions where the size of the skin layer appreciably exceeds the radius of the plasma column and the skin may be neglected. Plasma compression toward the axis of discharge will occur as a result of ambipolar drift of ions and electrons in the longitudinal magnetic field, which increases with time, and in the induced azimuthal electric field. Equations describing the θ pinch are integrated on a computer, the ion concentration and electron temperature profiles are calculated, and the time dependence of the total number of particles in the column is determined. Several approximate analytical calculations of the same parameters are made, and the results are found to be in good agreement with these obtained by computer. (IAA)

19872 NUMERICAL SIMULATION OF CURRENT SHEET SEPARATION IN A "PLASMA-FOCUS"-TYPE DEVICE. Gureev, K. G.; Filippov, N. V.; Filippova, T. I. (Inst. of Atomic Energy, Moscow). Fiz. Plazmy; 1: 120-126(1975). (In Russian)

On the basis of a numerical model of current sheet separation in a plasma-focus-type device operating in electrode discharge regime, the current distribution at the anode surface during separation is studied, and the role of metal vapor during separation is quantitatively estimated. It is assumed that in the near-electrode region, current can flow in the zone between the inner radiating current front and the outer boundary of the plasma sheet, the periphery in which the main mass of gas is concentrated. The separation region is modeled in the form of N parallel electric circuits, distributed uniformly. It is shown that from the moment of the thermal explosion of the anode surface, the chamber operates as an inductive accumulator, whose magnetic energy is stored in the volume bounded by the current front and the periphery of the plasma sheet. (IAA)

19873 FLUCTUATIONS IN A TURBULENT PLASMA. Sitenko, A. G. (Inst. of Theoretical Physics, Kiev). Fiz. Plazmy; 1: 45-59(1975). (In Russian)

Fluctuations in a nonequilibrium plasma are investigated taking nonlinear wave interaction into account, and the scattering and transformation of the plasma waves are examined. A system of nonlinear equations is derived for the sequence of correlation functions characterizing the fluctuations, and consideration of the nonlinear wave interaction is shown to eliminate the discrepancies in the spectral distributions that arise in a linear approximation. Saturation of the fluctuation level is linked directly with the presence of natural-frequency shifts caused by the nonlinear interaction. It is shown that a steady turbulent state is possible in a nonequilibrium plasma and that the fluctuation level in this case may significantly exceed the thermal level. A generalized kinetic equation is derived which describes the dynamics of plasma waves with allowance for interaction with fluctuating fields in the plasma. (IAA)

19874 DIRECT AND INVERSE TIME-EVOLUTION PROPAGATORS. General Properties and Application to Plasma Turbulence. Misguich, J. H. (CEN, Fontenay-aux-Roses, France); Balescu, R. Bull. Cl. Sci., Acad. R. Belg.; 61: No. 3, 210-246(1975).

The solution of a general evolution equation $\partial_t f(t) = C(t)f(t)$ that describes the time evolution of a function f in terms of a general time-dependent differential operator C(t), is given in terms of time evolution operators. The explicit solution for the direct and inverse propagators are shown to satisfy separately a semi-group property. A simple prescription concerning the time-ordering allows one to define a general operator, describing both direct and inverse time propagations, satisfying the group property. An interaction representation is given to derive useful expressions involving new operators which are dressed either by an external force, or by a free propagation. As an application, useful compact expressions are obtained for the free propagator in a constant magnetic field and for the propagator of Vlasov plasma turbulence. On the other hand, two examples are given to show how this interaction representation can be used to define two new approximations which could be useful to go beyond the usual weak coupling approximation of plasma turbulence. (auth)

19875 FORM OF A STEADY PLASMA SUBJECT TO THE SKIN EFFECT IN A TOKAMAK WITH NON-CIRCULAR CROSS-SECTION. Demidov, A. S. (Moscow State Univ.). Nucl. Fusion; 15: No. 5, 765-768(Oct 1975).

The paper gives sufficient conditions for a plasma to be only simply connected. An example is given of the case where a plasma must have more than one component of connectivity or, as we say in what follows, must be a multi-component plasma. The conditions under which a plasma can be both simply connected and multicomponent are also described. (auth)

19876 INFLUENCE OF A CIRCULARLY POLARIZED RF ELECTRIC FIELD ON A BEAM—PLASMA SYSTEM. Paverman, V.S.; Khirseli, E.M.; Tsintsadze, N.L. (Institute of Physics, Academy of Sciences of the Georgian, SSR, Tbilisi). Sov. Phys.—Tech. Phys. 20: No. 4, 449-452 (Apr 1975).

The influence of a circularly polarized rf electric field on a system consisting of an electron plasma and an electron beam is analyzed. The field is assumed to be homogeneous and the electrons in the plasma and beam are assumed to be cold. The ions are assumed to be fixed and to neutralize the electron charge. It is shown that such a field can, for certain values of the parameters, stabilize some previously known instabilities. In other cases it leads to new quasilongitudinal and quasitransverse instabilities. (auth)

19877 END SHORTING INDUCED ROTATION IN A θ PINCH. Kadish, A. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). Phys. Fluids 19: No. 1, 141-148 (Jan 1976).

A possible explanation for the observed rotation in open ended θ-pinch devices is shown to result from the shorting out of electric field components at the insulating boundary. The propagation of rotation into the plasma is primarily via torsional Alfvén waves preceded by dispersive precursors. The precursors have spatially and temporally modulated amplitudes. They are due to gyrofrequency oscillations of the plasma and are seen throughout the plasma immediately following the shorting out of the electric field components at the insulators. (auth)

19878 ORTHOGONAL CONDUCTIVITY OF A TOROIDAL PLASMA. Boozer, A.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 19: No. 1, 149-154 (Jan 1976).

The orthogonal conductivity of a toroidal plasma is calculated in the fluid regime. If the damping time for toroidally directed angular momentum is τ_N, the orthogonal conductivity is shown to be $\sigma_\perp = (\rho c^2/B_p^2)/\tau_N$ for large τ_N. Here ρ is the mass density, c is the speed of light, and B_p is the poloidal component of the magnetic field. For large τ_N, the flow induced by the orthogonal electric field is almost purely toroidal and of magnitude $c\,(E_r - E^0_r)/B_p$ where E^0_r is the electric field required for ambipolar diffusion. (auth)

19879 TRANSPORT PROPERTIES OF A TOROIDAL PLASMA IN A MIXED COLLISIONALITY REGIME. Hirshman, S.P. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Fluids 19: No. 1, 155-158 (Jan 1976).

The transport coefficients are calculated for an axisymmetric toroidally confined plasma comprised of main ions in the banana regime and high-Z impurities in the Pfirsch–Schlüter regime. The ambipolar particle diffusion coefficient scales like the Pfirsch–Schlüter value for a collisional plasma. The main ion heat conductivity, however, equals its value in a low collision frequency (banana regime) plasma, thus exceeding the particle diffusion by the factor $\delta^{-3/2}$, where $\delta < 1$ is the inverse aspect ratio. A neoclassical current comparable to the banana regime bootstrap current flows in response to the electron and ion gradients. (auth)

19880 EXISTENCE AND CONVERGENCE PROOF IN THE CALCULATION OF AXISYMMETRIC MAGNETOHYDROSTATIC EQUILIBRIA. Sestero, A. (Laboratori Gas Ionizzati, Assoc. CNEN-Euratom, Frascati, Rome, Italy). Phys. Fluids 19: No. 1, 167-168 (Jan 1976).

A typical interation scheme for the calculation of axisymmetric magnetohydrostatic equilibria is examined, and an existence and convergence proof is derived, in terms of a few classical results of functional analysis. (auth)

19881 KINETIC THEORY OF A RELATIVISTIC BEAM. Lee, E.P. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 19: No. 1, 60-69 (Jan 1976).

A Fokker–Planck equation is derived to study the evolution of a stable, low-current beam propagating in a gas-plasma medium. Small-angle scattering of the beam particles by the medium causes diffusion in the phase space projected transverse to the direction of propagation. The projected components of dynamical friction vanish. As a result, there is a continued input of energy into the transverse particle motions, which is taken up in expansion against the pinch field. A quasi-static Bennett equilibrium, with isothermal distribution of transverse momenta, is shown to be a similarity solution of the Fokker–Planck equation with scale radius increasing in accord with Nordsiéck's formula. An H theorem is proved and the Bennett distribution is shown to minimize both H and $-dH/dt$; hence, it is the time-dependent asymptotic state. The predicted current profile and radius are shown to be in fair agreement with experiment. (auth)

19882 COLLECTIVE CONTRIBUTION TO THE ENERGY LOSS OF A FAST ION IN A DEGENERATE ELECTRON-ION PLASMA. Cover, R.A. (KMS Fusion, Inc., Ann Arbor, Michigan 48106); Kalman, G.; Smirnoff, B.J. Phys. Rev. A 13: No. 1, 490-491 (Jan 1976).

The energy loss of a fast ion to a degenerate electron-ion plasma via the excitation of ion waves is calculated by the dielectric-function formalism. This collective contribution is at most a few percent of the energy loss due to ion-ion collisions for plasmas in the laser fusion domain, but can be a significant fraction of the total energy loss to ions in higher-density plasmas encountered in astrophysical situations. (auth)

19883 CTR PARAMETER STUDIES USING MULTIGROUP DIFFUSION EQUATIONS. Southworth, F. H.; Wells, W. E. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 72-74(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19884 PLASMA TRANSPORT THEORY IN TOKAMAKS. Sigmar, D. J. (Massachusetts Inst. of Tech., Cambridge). Trans. Am. Nucl. Soc.; 22: 267-268(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19885 ONE-DIMENSIONAL PLASMA TRANSPORT CALCULATIONS IN TOKAMAKS. Hogan, J. T. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 268-269(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19886 TRANSFORMATION OF THE SINGLE-ENERGY-GROUP TRANSPORT EQUATION TO AXISYMMETRIC TOROIDAL COORDINATES. Gralnick, S. L. (Princeton Plasma Physics Lab., NJ). Trans. Am. Nucl. Soc.; 22: 269-270(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19887 SPLIT SOLUTION FOR PARTICLE TRANSPORT IN TOROIDAL PLASMA DEVICES. Hennart, J. P. (Universidad Nacional Autonoma de Mexico, Mexico City); Martin, J.; Sanchez, J. Trans. Am. Nucl. Soc.; 22: 270(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19888 MONTE CARLO SIMULATION OF NEUTRAL BEAM INJECTION INTO FUSION PLASMAS. Miller, R. L.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 270-271(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19889 FINITE ELEMENT CODE TO SIMULATE ANISOTROPIC PLASMA DIFFUSION IN LINEAR MULTIPOLES. England, R. (Instituto Politecnico Nacional, Mexico City); Hennart, J. P.; Martin, J. G.; Melendez L., L. Trans. Am. Nucl. Soc.; 22: 271-272(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19890 MATRIX ANALYSIS AND NETWORK REPRESENTATION OF A MULTICOMPONENT PLASMA. Bayrakci, H. E. Istanbul Tek. Univ. Bul.; 26: No. 1, 39-64(1973).

The Maxwell–Euler equations are considered for a field which has three components and in which collisions occur. Use is made of the solutions which are obtained by a transformation from the space and time variables to the propagation $\bar{k}$ and the angular frequency ω. The vector components of the solutions which are parallel to $\bar{k}$ and perpendicular to $\bar{k}$ are arranged in the form of Kirchkoff's current and voltage laws. By the analysis of the impedance matrix thus obtained, and by the synthesis of the parts of the matrix, a comparative study of circuit duals of anisotropic plasmas which have one, two, and three components is done. (auth)

19891 THEORY OF PLASMA SIMULATION USING MULTIPOLE-EXPANSION SCHEME. Chen, L.; Okuda, H. (Princeton Univ., NJ). J. Comput. Phys.; 19: No. 4, 339-352(Dec 1975).

Nonphysical grid effects in plasma simulation using the multipole-expansion scheme and Gaussian-shape charge particles are studied analytically in one dimension. General expressions for the linear dispersion relation, fluctuation spectra, energy, and momentum conservations are derived and then compared with those of the Cloud-in-Cell (CIC) scheme using cell-size clouds. The results indicate that the dipole-expansion scheme and its subtracted version have, in general, grid effects comparable to CIC. Grid effects, however, are greatly reduced in schemes keeping higher-order moments, such as the quadrupole-expansion scheme. (auth)

Plasma Stability

Refer also to abstract 19818.

19892 (CONF-7509104-1) EFFORTS TO STABILIZE THE M EQUALS 2 HELICAL INSTABILITY IN ATC. Bol, K.; Ellis, R. A. Jr.; Hsuan, H. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1975. 14p. Dep. NTIS $3.50.

From Soviet-American seminar on feedback and dynamic stabilization of high temperature plasmas; Sukhuric, Union of Soviet Socialist Republics (USSR) (23 Sep 1975).

Experiments show that there is no difficulty about interacting with a 2/1 mode in ATC, and that given sufficient gain and a harmonic-free control winding the probability of stabilizing it is good. Control by steadily applied, DC quadrupole fields, on the other hand, on the basis of experiments with ATC as well as Pulsator, would seem at this juncture to have a small chance of success. Finally, the high currents achieved in gettered discharges offer the possibility that if control of wall emission can be achieved—e.g., with a divertor—one may simultaneously achieve a measure of control of the 2/1 and higher modes. (auth)

19893 (MATT-1157) UPPER HYBRID SOLITONS AND OSCILLATING-TWO-STREAM INSTABILITIES. Porkolab, M.; Goldman, M. V. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 48p. Dep. NTIS $4.00.

A warm two-fluid theory of soliton formation near the upper-hybrid frequency is developed. Several forms of the nonlinear Schroedinger equation are obtained, depending on whether the electric field is completely perpendicular to the dc magnetic field or whether it has an additional small component parallel to the magnetic field. For the perpendicular case, the character of the soliton depends on its scale length, L, and on beta. For low beta, when L is less than c/omega/sub pe/, one finds stationary envelope and hole solitons, whereas when L is greater than c/omega/sub pi/ we obtain the super-Alfvenic solitons described by Kaufman and Stenflow by MHD theory. However, the case E/sub parallel/ not equal to 0 may be of more interest, since it couples the pump to the excited waves more efficiently. In the limit of linearization about an infinite wavelength pump, the nonlinear Schroedinger equations yield purely growing (oscillating-two-stream) instabilities in both cases. (auth)

19894 (MATT-1208) FILAMENTATION INSTABILITY OF LOWER HYBRID WAVES IN A PLASMA. Kaw, P. K. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Feb 1976. Contract E(11-1)-3073. 12p. Dep. NTIS $3.50.

It is shown that a strong lower hybrid wave is modulationally unstable to perturbations propagating along its own wave vector. The instability relies critically on the finite thermal corrections to the lower hybrid dispersion relation. (auth)

19895 (UCID-17038) PRESENT STATUS OF MIRROR STABILITY THEORY. Baldwin, D. E.; Berk, H. L.; Byers, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Feb 1976. Contract W-7405-Eng-48. 63p. Dep. NTIS $5.45.

A status report of microinstability as it applies to 2XIIB and MX theory for mirror machines is presented. It is shown that quasilinear computations reproduce many of the parameters observed in the 2XIIB experiment. In regard to large mirror machines, there are presented detailed calculations of the linear theory of the drift cyclotron loss-cone mode, with inhomogeneous geometry and nonlinear diffusive effects. Further, the stability of a mirror machine to the Alfven ion-cyclotron instability is assessed, and the Baldwin-Callen diffusion is estimated for a spatially varying plasma. (auth)

19896 EXPERIMENTAL EVIDENCE OF PARAMETRIC INSTABILITIES IN AN UNMAGNETIZED PLASMA SUBJECTED TO A STRONG hf ELECTRIC FIELD. Moisan, M.; LePrince, P. (Univ. of Montreal, Quebec). Beitr. Plasmaphys.; 15: No. 3, 83-104(1975).

Experimental evidence of parametric excitation, by an intense external hf field, of an electron surface mode and an ion wave is presented. The pumping electromagnetic energy density is equal to or slightly larger than the thermal energy density of the electrons. The value of f_{pe}/f_0 (electron plasma frequency/external field frequency) is that for an electron surface wave. Depending on the pressure and field intensity, this decay instability can lead to three types of low frequency oscillations with frequencies close to the ion plasma frequency. Two of these are described by Aliev and Silin's intense field theory: one is the volume ion plasma oscillation and the other a surface ion plasma oscillation. The third corresponds to no known ion eigenmode. Several other features of the theory by Aliev and co-workers are also confirmed experimentally, such as the harmonic excitation of the instability ($nf_0 \approx f_{pe}/\sqrt{2}$, where n is an integer), the instability amplitude as a function of f_{pe}/f_0 (above threshold conditions), the value of the mismatch parameter as a function of field strength and ion mass, and the existence of a fine structure corresponding to the symmetric and antisymmetric electron surface oscillations. Even at high pump field strengths, the decay products are nearly monochromatic i.e. the plasma does not become turbulent. (auth)

19897 PARAMETRIC EXCITATION OF ELECTROSTATIC SURFACE WAVES IN AN INHOMOGENEOUS PLASMA LAYER BY AN AMPLITUDE MODULATED UHF PUMP FIELD. Aliew, J. M.; Gradow, O. M.; Suender, D. (Lebedev Inst. of Physics, Moscow). Beitr. Plasmaphys.; 15: No. 3, 105-110(1975). (In German)

Parametric resonance phenomena are investigated in a plasma layer with thickness d and thin inhomogeneous boundary regions. The modulated UHF electric field is parallel to the plasma layer. Both strong and low modulation of the field amplitude is considered and it is supposed that the carrier frequency ω_0 of the pump wave is much larger than the Langmuir frequency ω_{Le}. One finds the region for the modulation frequency Ω, in which the parametric growing of the asymmetric and symmetric surface waves occurs. The maximum growth rates of these waves, the direction of their propagation and the threshold value of the modulation depth α of the UHF pump field are calculated. (auth)

19898 STABILIZATION OF FLUTE INSTABILITY IN A DILUTE PLASMA BY AN UNCOMPENSATED SPACE CHARGE. Putvinskii, S. V. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 15: No. 5, 723-727(Oct 1975).

An uncompensated space charge was used to stabilize the flute instability in a dilute plasma ($\omega_{pi}^2 < \Omega_i^2$, where ω_{pi} and Ω_i are the ion plasma and ion cyclotron frequencies, respectively). For typical devices, this condition is fulfilled when the plasma density $n < 10^{10}$ cm^{-3}. It is shown that, if the space charge is sufficiently high, the flute instability is completely stabilized. The critical plasma decompensation ($n_{i0}-n_{e0}/n_{e0}$) needed to stabilize different oscillation modes and the dependence of that critical value on plasma density, the ion Larmor radius and the plasma-to-wall gap are established. (auth)

19899 EQUILIBRIUM AND STABILITY INVESTIGATIONS IN THE BELT PINCH. Krause, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 15: No. 5, 855-863(Oct 1975).

Experimental results obtained in the Garching Belt Pinch I are summarized. Here, toroidal high-β-plasmas are produced by shock heating, the plasma cross-section being highly elongated in the direction of the major torus axis. The plasma can be confined for about 100 μs until the toroidal plasma current is Ohmically damped out. With various diagnostic techniques, it is shown that the plasma reaches a quasi-stationary equilibrium in shape, temperature and density after about 25 μs. This equilibrium is investigated and compared with theoretical predictions. In the experiment, the plasma displays macroscopically stable behavior for low plasma currents. If the plasma current is increased gradually, the first instability that occurs is an m = 1, n = 1 kink mode. This mode is excited artificially by a suitable current pulse in an external coil in order to determine the stability limit. For a plasma with highly elongated cross-section area (axis ratio $\epsilon = 5-6$), the stability limit $q_{crit} = 2.4$ is found. (auth)

19900 HYDROMAGNETIC BEAM INSTABILITY IN TOKAMAK WITH NEUTRAL ATOM INJECTION. Mikhailovskii, A. B. (Inst. of Atomic Energy, Moscow). Fiz. Plazmy; 1: 72-80(1975). (In Russian)

The stability of a plasma containing a cluster of high-speed ions is theoretically investigated to clarify the processes which must occur in a tokamak plasma with injection of a beam of high-speed neutral atoms into it. The curvature of the magnetic field of a toroidal trap is accounted for, and a class of ion beam instabilities is recognized which constitutes a distinctive hybrid of beam and hydromagnetic instabilities. The frequency of such instabilities is shown to be on the order of the reverse transit time of the beam ions along the larger azimuth of tokamak; the increment is dependent on the ratio of the beam and plasma densities. Time-dependent oscillations are shown to be Alïven waves localized near the rational magnetic surfaces. (IAA)

19901 STABILITY OF A HOMOGENEOUS PLASMA WITH AN UNSTEADY PARTICLE VELOCITY DISTRIBUTION. Kitsenko, A. B.; Panchenko, V. I.; Stepanov, K. N. (Kharkov State Univ.). Fiz. Plazmy; 1: 32-44(1975). (In Russian)

Oscillations of a homogeneous unsteady plasma are investigated for a case where the particle velocity distribution function results from a random, spatially uniform perturbation arising during the injection of modulated streams of charged particles into the plasma. It is shown that in the case of weak modulation of the distribution function under conditions of parametric resonance, an instability will always occur if the interaction of resonant particles with plasma oscillations is substantial. A parametric instability will occur even when the interaction with resonant particles can be neglected if the plasma natural oscillation frequencies have two different values. The quasi-linear development stage of oscillations is investigated, and calculations indicate that either the oscillations will attenuate or the modulation of the resonant particle distribution will vanish due to quasi-linear relaxation. (IAA)

19902 PARAMETRIC INSTABILITIES BELOW THE ELECTRON PLASMA FREQUENCY DUE TO RELATIVISTIC CORRECTIONS. Bourdier, A.; Di Bona, G.; Fortin, X.; Masselot, C. (Commissariat à l'Energie Atomique, Centre d'Etudes de Limeil, B.P. 27, 94-Villeneuve Saint Georges, France). Phys. Rev. A 13: No. 2, 887-890 (Feb 1976).

We present a model which describes the interaction of a cold homogeneous plasma with a strong linearly polarized external electromagnetic wave, taking into account relativistic terms. Instabilities appear for transverse and longitudinal waves when the pump-field frequency is at the same time below the electron plasma frequency and above but very near the cutoff frequency obtained by Kaw and Dawson with a nonlinear relativistic theory. (auth)

19903 TRAPPED PARTICLE INSTABILITY. Franklin, R.N.; MacKinlay, R.R. (Culham Laboratory, United Kingdom Atomic Energy Research, Abingdon, Oxfordshire, United Kingdom). Phys. Fluids 19: No. 1, 173-174 (Jan 1976).

A quasi-linear treatment of the time evolution of a large amplitude electron plasma wave following trapped particle orbits shows no instability at wave amplitudes given by $e\phi_0/\kappa_B T_e \leq 0.1$ in contrast to experimental observations and earlier theoretical results. (auth)

19904 OPTIMUM COUPLING CONDITION FOR THE TWO-STREAM INSTABILITY. Mross, M.R.; Walsh, J.E. (Department of Physics and Astronomy, Dartmouth College, Hanover, New Hampshire 03755). Phys. Fluids 19: No. 1, 171-172 (Jan 1976).

The power transferred from an electron beam to longitudinal electrostatic fluctuations in a low energy beam-plasma system is found to be optimal when the beam velocity and the long wavelength asymptote to the phase velocity of the longitudinal modes are approximately equal. (auth)

19905 NONLINEAR DEVELOPMENT OF ABSOLUTE AND CONVECTIVE INSTABILITIES. Seidl, M.; Carr, W.; Boyd, D.; Jones, R. (Department of Physics, Stevens Institute of Technology, Hoboken, New Jersey 07030). Phys. Fluids 19: No. 1, 78-92 (Jan 1976).

The instability resulting from the interaction of a weak, monoenergetic electron beam with a magnetoplasma ($\omega > \omega_{CE}$) has been studied experimentally. A calculation, using the dispersion relation appropriate to the experiment, shows that the interaction may take the form of convective or absolute instability, depending on plasma temperature. This is in qualitative and quantitative agreement with the experiment. The convective mode has spatially amplified waves which are steady state in time. Saturation is due to beam trapping, and agrees quantitatively with a trapping calculation which includes cyclotron damping. After saturation the wave damps, which is attributed to untrapping of the beam by relatively low-level amplified plasma noise. The absolute instability is a feedback oscillation due to the negative group velocity in the plasma. It rises suddenly to large amplitude near the electron gun and has a short over-all length. There are two nonlinear states: one is steady state in time, and agrees with a beam trapping calculation for absolute instability; the second has temporal quenching, or relaxation oscillations. This is attributed to the interaction of several oscillation modes strongly coupled by the nonlinear beam dynamics. This effect may limit wave amplitudes below the value predicted by trapping theory. (auth)

19906 MICROINSTABILITY THEORY OF TWO-ENERGY-COMPONENT TOROIDAL SYSTEMS. Berk, H. L. (Univ. of California, Livermore); Horton, W. Jr.; Rosenbluth, M. N.; Rutherford, P. H. Nucl. Fusion; 15: No. 5, 819-844(Oct 1975).

The microinstability theory of the two-energy-component toroidal system is developed and applied to systems typical of those in proposed fusion break-even experiments. The energetic ion beam distributions F/sub b/(v/sub parallel/,v/sub perpendicular/,t) obtained from approximate solutions of the Fokker–Planck equation are studied for high-frequency microinstabilities arising from delta F/sub b//delta v^2/sub parallel/ greater than 0 or delta F/sub b//delta v^2/sub perpendicular/ greater than 0 in both transient and collisional equilibrium states. For typical beam-plasma parameters, the system is shown to be stable to high-frequency modes during the parallel injection of a continuous, monoenergetic source. (auth)

19907 MERCIER STABILITY OF NON-CIRCULAR CROSS-SECTION CONFIGURATIONS. Galvao, R. M. O. (Massachusetts Inst. of Tech., Cambridge). Nucl. Fusion; 15: No. 5, 785-792 (Oct 1975).

Stability against flute modes, localized inside the plasma column, of magnetic confinement configurations which are relevant for the realization of poloidal divertors, is studied for a bell-shaped current-density profile. The ideal MHD-equilibrium is described by using the Herrnegger–Maschke solutions of the equilibrium equations. It is shown that there is little difference between the stability conditions for toroidal diffuse pinches with the shape of the cross-section resembling a normal or inverted D, and that these two shapes of the plasma cross-section are preferable to a rectangular one if the plasma column is very elongated in the vertical direction. A comparison is made with the results based upon a flat-current-density equilibrium model. (auth)

19908 NONLINEAR THEORY OF THE TRAPPED-PARTICLE INTERCHANGE MODE. Waddell, B. V. (Inst. of Advanced Study, Princeton, NJ). Nucl. Fusion; 15: No. 5, 803-811(Oct 1975).

In studying the nonlinear evolution of nonresonant trapped-particle instabilities, it is desirable to exploit the fact that their frequencies are smaller than the bounce frequency by employing a kinetic equation for the bounce-averaged distribution function. Such an equation for trapped particles is derived in axisymmetric toroidal geometry by transforming the familiar drift-kinetic equation to toroidal co-ordinates and employing an annihilation operator. The "bounce-averaged drift-kinetic equation" facilitates the application of Dupree's strong turbulence formalism in toroidal geometry, under the assumption that turbulent scattering of particles out of magnetic well is unimportant. On the basis of this formalism, the trapped-particle interchange mode is analyzed. The saturation amplitude of the instability and the corresponding turbulent transport coefficients are obtained. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 19832, 19834, 20640, 20697, 20703, 20853–20856, 21101, and 21255.

19909 (ANL-Trans-1031) CONDITIONS OF VACUUM PHYSICS FOR SELECTION OF THE MATERIAL OF FIRST WALL AND DIAPHRAGM OF THE DEMONSTRATION THERMONUCLEAR REACTOR-TOKAMAK (T-20). Gusev, V. M.; Guseva, M. I.; Gervids, V. I.; Kogan, V. I.; Martynenko, Yu. V.; Mirnov, S. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Jan 1976. Translation of IAE-2545. 15p. Dep. NTIS $3.50.

A model is given for plasma interaction with the wall and the introduction of contaminants. The model was characterized by two kinds of uncertainty. First, the uncertain behavior of the contaminants, and second, the uncertainty of boundary conditions. Some of the conclusions from the study are described. (MOW)

19910 (BNL-20727) SURVEY OF DRIVEN TOKAMAKS IN EPR AND COMMERCIAL REACTOR APPLICATIONS. Usher, J. L.; Powell, J. R. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 16p. (CONF-751125-139). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Evaluation of plasma parameters of driven and ignited Tokamaks for use in experimental power reactor (EPR) and commercial reactor applications has been performed. The purpose of this study is to evaluate the most pessimistic conditions under which a power producing reactor could be operated assuming the use of a high efficiency power (HEP) cycle. The adoption of the HEP cycle will enable a power producing reactor to operate with a plasma Q of 1.5 or less as opposed to a required Q of approximately 8.0 utilizing a conventional conversion cycle. Q is defined as the ratio of thermal fusion power produced to beam input power required. Pessimistic assumptions of large impurity concentrations and short confinement times are made in order to determine the regimes of operation the HEP cycle would render accessible. Characteristic values of plasma and reactor parameters are listed for each of three reactor models for both EPR's and commercial reactors and the favorable implications of the HEP cycle are delineated. (auth)

19911 (BNWL-1961) SOME EXPERIMENTAL CONSIDERATIONS REGARDING ION BEAM SIMULATION OF NEUTRON IRRADIATION FOR MECHANICAL PROPERTY MEASUREMENTS. Styris, D. L.; Jones, R. H.; Harling, O. K.; Kulcinski, G. L.; Marshall, R. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 122p. Dep. NTIS $5.50.

A preliminary assessment of the requirements for mechanical property data related to CTR materials is given. The status of ion simulation for mechanical property measurements is described. A damage analysis and calculations for light ions are presented along with sample size, heating and cooling, and surface considerations. (MOW)

19912 (EUR-5370e, pp 359-360) TFR DATA ACQUISITION. Idmtal, J.; Vernet, P. (CEN, Fontenay-aux-Roses, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

This paper deals with the problems of the data acquisition on a big physical experiment (Tokamak device) using high energy power supplies and needing the acquisition of a great number of words. (auth)

19913 (IPPJ-205) PROJECT JIPP T-II. (Nagoya Univ. (Japan)). Nov 1974. 35p. Dep. NTIS (US Sales Only) $5.00.

The project of JIPP T-II aims to study the confinement of hot plasma in a toroidal magnetic field and the heating mechanism of the confined plasma. The understanding of the stellarator experimental results and the achievement of tokamaks to confine hot plasma led to the construction of a new device in order to investigate plasma transport and heating. JIPP T-II is a hybrid stellarator–tokamak which is equipped with helical field and the feedback control system for the vertical field. The toroidal plasma with longitudinal current can be maintained in equilibrium position beyond the skin time of the shell by controlling the vertical field during discharge. The plasma transport phenomena in the stellarator field can be investigated, and the scaling law for plasma confinement can be compared with that of the tokamak under similar boundary conditions and using the same device. The temperature of plasma produced by ohmic heating is limited due to the reduction of resistivity of the high temperature plasma. The study of further heating methods is essential to reach higher temperatures. (JA)

19914 (JAERI-M-6018) NUMERICAL METHOD TO OBTAIN THE OPTIMUM CONFIGURATION OF EXTERNAL MAGNETIC FIELD COILS IN A TOKAMAK DEVICE. Toi, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1975. 40p. Dep. NTIS (US Sales Only) $5.00.

In large tokamak devices in the next phase of fusion research, it seems that equilibrium of the toroidal plasma is maintained essentially by the external control loops and an air-core transformer is used instead of a conventional iron-core transformer. Under this situation the method based on the optimization process using the algorithm of a nonlinear programming has been applied in determination of the optimum design of the external magnetic field coils including the control loops for maintaining magnetic field and primary windings of the air-core transformer. It is found that the method is useful for design of the control loops and primary windings in a practical tokamak. The results obtained so far are presented and the procedure of optimization is given in detail and comprehensively. (auth)

19915 (MATT-1179) FAULT PROTECTION FOR NEUTRAL-BEAM INJECTION SYSTEMS. Knauer, R. C.; Ashcroft, D. L.; Murray, J. G.; Newman, R. A. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 13p. (CONF-751125-117). Dep. NTIS $4.00.

From IEEE sixth symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper discusses the accelerating, or main supply for the Neutral Injection System on PLT and, in particular, provides evaluation of a system for protection against the possibility of an arc developing in the accel portion of the ion source gun. The design of a protection scheme utilizing a fast turn-on and turn-off ignitron crowbar is described and evaluated. This crowbar is used to provide backup protection for the ion source high power vacuum tube used as a voltage regulator and series switch. Ignitron crowbars are proposed for use as primary protection of the 150 KV ion source being developed for the Tokamak Fusion Test Reactor (TFTR) if a 150 KV switch tube is not readily available and inexpensive. (auth)

19916 (MATT-1183) VACUUM AND WALL PROBLEMS IN PRECURSOR REACTOR TOKAMAKS. Cohen, S. A. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. (CONF-751023-6). Dep. NTIS $5.45.

From 22nd national vacuum symposium; Philadelphia, Pennsylvania, USA (28 Oct 1975).

The Princeton Large Torus (PLT) will be completed in 1975 and two other CTR oriented toroidal plasma devices, the Poloidal Divertor Experiment (PDX) and the Tokamak Fusion Test Reactor (TFTR), are planned to be completed in 1977 and 1981. The vacuum systems of these machines must satisfy stringent requirements because of unusual operating conditions, such as, magnetic field induced strains and eddy currents, energetic particle and photon bombardment, large transient gas loads, and the use of 100 Curie quantities of tritium. In addition, novel vacuum wall surfaces and fast moving mechanical or magnetic plasma limiters will be required to minimize the influx of impurities during discharges. (auth)

19917 (ORNL/TM-5114) INFLUENCE OF THE MINOR PERIODICITY ON MAGNETIC ISLAND FORMATION IN TOKAMAKS. Matsuda, S. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 27p. Dep. NTIS $5.00.

This report describes the formation of magnetic islands due to external error fields. In particular, magnetic fields due to the ohmic heating and vertical field coils that appear at the shell gaps make islands of significant size. Moreover, the toroidal minor periodicity of these perturbation fields, which is generally represented by the number of shell gaps, has an important meaning for suppression of the resonant magnetic islands. (auth)

19918 (ORNL-TM-5184) LETTER REPORT FOR THE SUPERCONDUCTING MAGNET DEVELOPMENT PROGRAM (NUMBER 4). Progress Report, June 1, 1975–September 1, 1975. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 36p. Dep. NTIS $5.00.

The program objectives are outlined. Brief discussions of research progress are given for the following: systems design, coil design, conductor selection and test, radiation effects, coil protection, structural analysis and material tests, cryogenics and refrigeration, coil fabrication, and coil test and evaluation. (MOW)

19919 (ORNL/TM-5280) SUGGESTIONS FOR AN UPDATED FUSION POWER PROGRAM. Clarke, J. F. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 20p. Dep. NTIS $5.00.

This document contains suggestions for a revised CTR Program strategy which should allow us to achieve equivalent goals while operating within the above constraints. The revised program is designed around three major facilities. The first is an upgrading of the present TFTR facility which will provide a demonstration of the generation of tens of megawatts electric equiv-

alent originally envisioned for the 1985 EPR. The second device is the TTAP which will allow the integration and optimization of the plasma physics results obtained from the next generation of plasma physics experiments. The improvement in tokamak reactor operation resulting from this optimization of fusion plasma performance will enable an EPR to be designed which will produce several hundred megawatts of electric power by 1990. This will move the fusion program much closer to its goal of commercial fusion power by the turn of the century. In addition to this function the TTAP will serve as a prototype of the 1990 EPR system, thus making more certain the successful operation of this device. The third element of this revised program is an intense radiation damage facility which will provide the radiation damage information necessary for the EPR and subsequent fusion reactor facilities. The sum total of experience gained from reacting plasma experiments on TFTR, reactor grade plasma optimization and technological prototyping on TTAP, and end of life radiation damage results from the intense neutron facility will solve all of the presently foreseen problems associated with a tokamak fusion power reactor except those associated with the external nuclear systems. These external system problems such as tritium breeding and optimal power recovery can be developed in parallel on the 1990 EPR. (auth)

19920 (RD/B/N-3263) REVIEW OF THE PROSPECTS FOR FUSION POWER GENERATION. Hall, R. S.; Blow, S.; Clarke, R. H.; Tozer, B. A.; Whittingham, A. C.; Bending, R. C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1975. 118p. (R/M/N-822). Dep. NTIS (US Sales Only) $5.50.

The physics and engineering problems of both magnetically and inertially (laser) confined fusion systems are reviewed. The materials problems of the two systems are discussed, and their safety implications analysed. A short discussion is given of the possibilities and problems of a hybrid fission/fusion system. (UK)

19921 (UCID-17002) H, D AND T PROFILING BY TIME-OF-FLIGHT. Davis, J. C.; Anderson, J. D.; Lefevre, H. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1976. Contract W-7405-Eng-48. 27p. Dep. NTIS $4.00.

An analytic technique has been developed to measure the depth profile of hydrogen isotopes implanted or absorbed in materials. To measure the depth profile of T (or D) in a sample, a probing beam of protons (or deuterons) is used and the spectrum of neutrons produced by the T(p,n) (or D(d,n)) reaction is measured by neutron time-of-flight. From the neutron energy, the depth in the target of the T (or D) atoms can be inferred. The profile can be determined to a depth of 20 to 40 mu m in a single measurement requiring only a few minutes. The technique is nondestructive, requires no special sample preparation, and may be used with samples which are radioactive or are mounted on thick backings. A sensitivity of 0.1 at. percent has been demonstrated in initial measurements. Ultimate sensitivity of 10^{-4} at. percent or greater may be possible. Depth resolution is limited by the time resolution of the time-of-flight spectrometer near the front surface of the sample and by energy straggling of the probing beam at depths beyond 1 to 2 mu m. Quantitative accuracy of 6 to 8 percent is readily obtained. We have measured depth profiles of D and T concentrations in neutron generator targets. The relaxation of an implantation spike of T in Ti and TiH samples has also been studied. Extension of the technique to depth profiling of H by using the inverse reaction H(t,n) is possible. (auth)

19922 (UCID-17025) MX DRAFT PROPOSAL. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Feb 1976. Contract W-7405-Eng-48. 216p. Dep. NTIS $7.60.

This is an interim report on the design of a large mirror fusion experiment, MX, that LLL is proposing to construct in FY 78-80. The MX experiment brings together the main elements of our present concept of a mirror reactor: a superconducting magnet and neutral beam injection. The plasma will be created by pulsed beam injection into a plasma stream injected along the magnetic field through the mirrors. This will be followed by sustained injection of high energy neutrals to achieve steady-state conditions for 0.5 to several seconds. (auth)

19923 (UCRL-52000-75-12) ENERGY AND TECHNOLOGY REVIEW. Carr, R. B. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1975. Contract W-7405-Eng-48. 29p. Dep. NTIS $4.00.

Brief discussions are given on research work at the National CTR Computer Center at Livermore, high-field superconducting magnets for fusion reactors, and digital image processing for plasma diagnostics. Some developmental work on multifilamentary superconductors of Nb–Ti and Nb–Sn is described. Some complex mathematical techniques for enhancing and restoring digital images for plasma diagnostics are discussed. (MOW)

19924 (UCRL-52008) STATUS REPORT ON MIRROR ALTERNATIVES. Condit, W. C.; Fowler, T. K.; Post, R. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1976. Contract W-7405-Eng-48. 56p. Dep. NTIS $4.50.

The present status of studies at Lawrence Livermore Laboratory (LLL) directed toward exploring variants on the basic magnetic mirror confinement concept is described. These studies have emphasized those ideas that could lead most directly to improvements in the scientific and economic viability of fusion reactors based on the mirror concept, within the general context of the extensive body of specialized physics and technology that has been developed in the course of the Mirror Program. (auth)

19925 (UCRL-77073(Rev.1)) LASER IRRADIATION OF PARYLENE DISKS WITH A 1.06 mu m LASER. Haas, R. A.; Phillion, D. W.; Boyle, M. J.; Kornblum, H. N.; Rupert, V. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1975. Contract W-7405-Eng-48. 26p. (CONF-751130-21). Dep. NTIS $4.00.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Parylene disks supported on glass stalks were irradiated with 1.06 mu m wavelength laser light pulses focused to flux intensities in the range from 10^{15} to 10^{17} W/cm^2. According to photodiode measurements the fraction of laser light absorbed, 25 to 50 percent, increased slightly as the laser intensity was increased. However, box calorimeter measurements implied that the fraction absorbed was approximately 30 percent and insensitive to irradiation intensity. Some x-ray spectra are discussed. (MOW)

19926 (UCRL-77645) FUEL CYCLE PROBLEMS IN FUSION REACTORS. Hickman, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jan 1976. Contract W-7405-Eng-48. 25p. (CONF-760203-3). Dep. NTIS $3.50.

From AIME annual meeting; Las Vegas, Nevada, United States of America (USA) (22 Feb 1976).

Fuel cycle problems of fusion reactors evolve around the breeding, recovery, containment, and recycling of tritium. These processes are described, and their implications and alternatives are discussed. Technically, fuel cycle problems are solvable; economically, their feasibility is not yet known. (auth)

19927 ANALYSIS OF MAGNETICALLY CONFINED PULSED-FUSION-REACTOR CONCEPTS. Koeppendoerfer, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 15: No. 5, 891-899(Oct 1975).

Different magnetically confined fusion reactor concepts, like the tokamak, the reversed-field pinch, the high-β stellarator and the linear θ pinch, are discussed by means of a few quantities prescribed by technical and physical requirements. These quantities are: the thermal reactor power, the wall power loading, the first-wall-to-plasma-radius ratio, the blanket thickness, the toroidal aspect ratio and the plasma β. Pulsed operation was included by introducing a dimensionless time τ, the ratio of the burning time to the pulse cycle time. Other reactor and plasma parameters are derived from these quantities. Under certain assumptions, the systems are compared on a simplified basis in different respects including the energy balance, the question of Ohmic power losses when normal conducting magnets are used, cost structure and fast power supplies. Finally, the main features and advantages of each concept are summarized. (auth)

19928 ILLUMINATION ASYMMETRIES IN LASER-INDUCED COMPRESSION. Ashby, D. E. T. F. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Fusion; 15: No. 5, 933-935(Oct 1975).

The scaling of the symmetrizing effect of thermal conductivity in laser-induced compression is considered. Two simple conditions are derived which indicate when symmetric flow to the ablating surface can be expected. (MOW)

19929 HIERARCHICAL SYSTEMATICS OF FUSION-FISSION ENERGY SYSTEMS. Harms, A. A. (McMaster Univ., Hamilton, Ont.). Nucl. Fusion; 15: No. 5, 939-944(Oct 1975).

A hierarchical framework is established for the study of fusion-fission systems based on gross reactor-physics parameters with emphasis on isotopic fuel power yield. A specific numerical example is presented and discussed. (MOW)

19930 TAMPED THERMONUCLEAR BURN OF DT-MICROSPHERES. Mason, R. J.; Morse, R. L. (Los Alamos, Scientific Lab., NM). Nucl. Fusion; 15: No. 5, 935-938(Oct 1975).

The evolution of numerous tamped fuel configurations was traced by computer simulation. Most of the runs used 10 mu g of DT fuel surrounded by from 10 mu g to 1 mg of tamper material. The effect of the fuel mass to tamper mass on ignition is discussed. (MOW)

19931 ION-BEAM COMPRESSION OF THERMONUCLEAR PELLETS. Shearer, J. W. (Univ. of California, Livermore). Nucl. Fusion; 15: No. 5, 952-955(Oct 1975).

A few numerical calculations of ion beam heating of small solid spherical D-T pellets are discussed. The code used is a two-temperature, ideal-gas, Lagrangian hydrodynamic calculation which includes thermal conduction and thermonuclear reactions. It includes a MonteCarlo calculation of deuterons, tritons, alpha particles, and helium-3. (MOW)

19932 DESTRUCTION OF MAGNETIC SURFACES IN TOKAMAKS BY CURRENT PERTURBATIONS. Finn, J. M. (Princeton Univ., NJ). Nucl. Fusion; 15: No. 5, 845-854(Oct 1975).

Investigations of the feasibility of the hypothesis that the disruptive instability in tokamaks is caused by the break-up of magnetic surfaces are presented. The envisioned break-up is caused by the interaction of m equals 2, n equals 1 and m equals 3, n equals 1 helical perturbations or by the interaction of the m equals 2, n equals 1 perturbation and the m equals 1, n equals 0 toroidal field (with R/a equals 5). Both numerical and analytic work has been done for two MHD-equilibrium current profiles: parabolic [q approximately $(1 - r^2/2a^2)^{-1}$] and the peaked model (q approximately 1 + lambda r^2/a^2). For the parabolic profile, perturbation strengths of 1.5 percent are required to break up surfaces when m equals 2 and m equals 3 perturbations are present. When the m equals 2 perturbation alone interacts with the toroidal field, perturbation strengths greater than 4 percent are required. For the peaked model with q(0) equals 1.1, q(a) equals 3.7, perturbation strengths of 0.5 percent were found to be sufficient to break the surfaces when both m equals 2 and m equals 3 perturbations are present, whereas strengths of 1.5 percent are required when only the m equals 2 perturbation interacts with the toroidal field. These perturbation amplitudes are in reasonable agreement with experimental measurements. The peaked model allows break-up of surfaces for smaller perturbation strengths, primarily because of its greater shear. This dependence on shear permits speculation on a possible mechanism for the disruptive instability. (auth)

19933 HIGH-POWER ISOLATOR FOR THE 10-μm REGION EMPLOYING INTERBAND FARADAY ROTATION IN GERMANIUM. Phipps, C.R. Jr.; Thomas, S.J. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Appl. Phys. 47: No. 1, 204-213 (Jan 1976).

Interband Faraday rotation in intrinsic germanium has been employed to construct a room-temperature optical isolator for use in the intermediate infrared region. The device was tested at 9.55- and 10.59-μ 10.59-μm wavelengths, and exhibited an isolation level of 41 dB at 10^6 W cm^{-2}. The rotation is shown to be relatively insensitive to temperature at the two wavelengths and linear in magnetic field intensity up to 83 kG. The isolator figure of merit is about 60 deg per dB attenuation. (auth)

19934 IMPACT OF PULSED ENERGY STORAGE REQUIREMENTS ON THE OVERALL ENERGY BALANCE IN FUSION REACTORS. Steiner, D. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 7(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

19935 ENERGY STORAGE AND SWITCHING FOR TOKAMAK FUSION REACTORS. Peterson, H. A.; Boom, R. W.; Lue, J. W.; Mohan, N.; Moses, R. W. (Univ. of Wisconsin, Madison). Trans. Am. Nucl. Soc.; 22: 7-9(Nov 1975).

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19936 ROLE OF FAST-DISCHARGING HOMOPOLAR MACHINES IN FUSION DEVICES. Swannack, C. (Los Alamos Scientific Lab., NM); Thomassen, K.; Weldon, D.; Rylander, G.; Tolk, K.; Weldon, W.; Woodson, H. Trans. Am. Nucl. Soc.; 22: 9-10(Nov 1975).

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19938 OPTIMIZING THE MIRROR (FUSION–FISSION) HYBRID REACTOR FOR PLUTONIUM PRODUCTION. Lee, J. D.; Bender, D. J.; Moir, R. W. (Univ. of California, Livermore). Trans. Am. Nucl. Soc.; 22: 11-12(Nov 1975).

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20001 IGNITION OF LARGE TOKAMAK PLASMAS BY A PROPAGATING THERMONUCLEAR BURN. Jassby, D. L.; Furth, H. P. (Princeton Plasma Physics Lab., NJ). Trans. Am. Nucl. Soc.; 22: 72(Nov 1975).
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20010 HYDROGEN ATTACK OF FUSION REACTOR FIRST WALLS MADE OF GRAPHITE. Balooch, M.; Olander, D. R. (Univ. of California, Berkeley). Trans. Am. Nucl. Soc.; 22: 164-165(Nov 1975).
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20011 DIFFUSIVITY PROBING IN DEUTERIUM-IMPLANTED MATERIALS WITH THE $^{3}H(d,n)^{3}He$ REACTION. Cowgill, D. F. (Sandia Labs., Albuquerque, NM). Trans. Am. Nucl. Soc.; 22: 168-169(Nov 1975).
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20013 DESIGN OF AN EXTREMELY VERSATILE, HIGH-FLUX [$\sim 10^{15}$ n/(cm^2 sec)] RADIATION TEST FACILITY FOR CTR. Batchelor, K.; Blewett, J. P.; Goland, A.; Grand, P.; Gurinsky, D.; Kukkonen, J.; Snead, C. L. Jr. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 170-171 (Nov 1975).
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20014 HIGH-ENERGY NEUTRON SPECTRA AT THE LAMPF RADIATION EFFECTS FACILITY. Simmons, M. L.; Dudziak, D. J. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 171-172(Nov 1975).
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20015 EVALUATION OF FISSION REACTORS FOR CTR MATERIALS DEVELOPMENT. Horak, J. A.; Steigler, J. O.; Wiffen, F. W. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 172-174(Nov 1975).
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20016 HIGH-ENERGY DISPLACEMENT CASCADES FROM NONELASTIC NEUTRON REACTIONS. Odette, G. R.; Doiron, D. R. (Univ. of California, Santa Barbara). Trans. Am. Nucl. Soc.; 22: 174-175(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20017 GLOBAL PLASMA MODELS FOR TOKAMAK ENGINEERING STUDIES. Stacey, W. M. Jr. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 267(Nov 1975).
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20018 REMOTE OPERATIONS IN A FUSION ENGINEERING RESEARCH FACILITY (FERF). Doggett, J. N. (Univ. of California, Livermore). Trans. Am. Nucl. Soc.; 22: 731-732(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20019 TRANSFER OPERATIONS WITH TRITIUM: A REVIEW. Folkers, C. L.; Gede, V. P. (Univ. of California, Livermore). Trans. Am. Nucl. Soc.; 22: 736-737(Nov 1975).
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20020 TRITIUM PERMEATION THROUGH MATERIALS FOR STEAM GENERATOR SYSTEMS. Bell, J. T.; Strehlow, R. A.; Redman, J. D.; Savage, H. C.; Smith, F. J. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 737-738(Nov 1975).
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20021 SELECTED TECHNIQUES FOR THE CONTROL AND HANDLING OF TRITIUM. Rhinehammer, T. B.; Lamberger, P. H. (Mound Lab., Miamisburg, OH). Trans. Am. Nucl. Soc.; 22: 740-741(Nov 1975).
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20022 CROSS-SECTION SENSITIVITY OF THE ENERGY DEPOSITION AND RADIATION DAMAGE IN THE TOROIDAL FIELD COIL OF A TOKAMAK EXPERIMENTAL POWER REACTOR. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 795-796(Nov 1975).
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20023 MORE EVIDENCE THAT FUSION WORKS. Ahlstrom, H. G.; Holzrichter, J. F. (Lawrence Livermore Lab., CA). Laser Focus; 1-4(Sep 1975).
Some results from laser-driven implosion experiments are described. Some neutron yield measurements are given along with computer simulation diagrams of imploding targets. (MOW)

20024 PROBLEMS POSED BY THE CONSTRUCTION OF A THERMONUCLEAR REACTOR. Bonnal, J. F.; Leloup, C. (EURATOM, Fontenay-aux-Roses, France). Entropie; 11: No. 61, 10-24(1975). (In French).
The main technical obstacles to the design and manufacture of an economical thermonuclear reactor are reviewed. The principal characteristics of a thermonuclear plasma and reactor are discussed, with particular reference to the main dimensions and power level. A Tokomak-type toroidal confinement reactor is described. Some characteristics of laser fusion and other reactor models are briefly considered. (STAR)

20025 OPTICS FOR LASER FUSION. Thomas, C. E. (KMS Fusion, Inc., Ann Arbor, MI). Laser Focus; 11: 49-51(Jun 1975).
To ensure uniform laser-driven implosion of targets, the system's optics must meet narrow tolerances in beam direction and target placement. An illumination system using two beams to achieve nearly uniform irradiance and neutron yields as high as 7 million per shot was developed. The use of two opposing ellipsoidal mirrors in the system increased the 80 deg cone angles of the aspheric focusing lenses to full-cone angles of 144 deg at the fuel pellet. Resulting data for elliptical-mirror illumination and for two-lens illumination are shown. Two closed-circuit television systems permit measurement of target displacements as small as 5 microns from the true focus. (STAR)

20026 LASER FUSION. Ashby, D. E. T. F. (UKAEA Research Group, Harwell). J. Br. Nucl. Energy Soc.; 14: No. 4, 311-317(14 May 1975).
From meeting of the British Nuclear Energy Society; London, Eng. (Oct 1975).
Basic principles of laser fusion are simply presented and the current status of research is described. Consideration is given to the need for, and achievement of, high densities, computer simulation of the physical processes, some of the physical problems involved in laser fusion, existing type of lasers, and future developments of new types suitable for laser fusion experiments and possibly for a reactor. Major research programs in various

centres are briefly outlined. Some results are given of compression experiments. (UK)

Wave Phenomena

Refer also to abstracts 19893 and 19894.

20027 WAVE PROPAGATION IN LOSSY WARM MAGNETOPLASMA. Rawat, S. S. J. Inst. Telecommun. Eng.; 21: 8-13 (Jan 1975).

This paper presents the study of behavior of the phase velocity and the attenuation distance of waves propagating arbitrarily in a homogeneous, driftless, warm electron magnetoplasma. Some illustrative graphs showing the variation of the phase velocity and the attenuation distance with respect to normalized source frequency for various values of normalized collision frequency are developed analytically to study the dispersion relation for a plasma wave. In order to obtain a simplified expression, the phase velocity and the attenuation distance are expanded in a power series in terms of normalized collision frequency and inverse of normalized collision frequency by Taylor's series theorem for the respective low-loss and high-loss cases of warm plasma. The approximate values of the phase velocity and the attenuation distance are also obtained in some regions of the frequency spectrum. (auth)

20028 NONLINEAR WAVE PROCESSES IN AN INHOMOGENEOUS PLASMA. Moiseev, S. S. (Physical-Technical Inst., Kharkov). Fiz. Plazmy; 1: 5-9(1975). (In Russian)

A short review is presented of the nonlinear effects involving conversion of the energy of harmonic oscillations in an inhomogeneous plasma and the transformation of stationary and simple waves. Attention is given to the following problems: determining the coefficients of nonlinear wave transformation, simultaneous calculation of interaction and self-action of waves, distortion of wave profiles during nonlinear interactions, spectral composition of generated waves, and the possibility of transforming a wave into a nonlinear wave of the same type. (IAA)

20029 NONLINEAR THEORY OF THE MODULATION INSTABILITY OF LANGMUIR WAVES. Galeev, A. A.; Sagdeev, R. Z.; Sigov, Yu. S.; Shipiro, V. D.; Shevchenko, V. I. (Inst. of Cosmic Research, Moscow). Fiz. Plazmy; 1: 10-20(1975). (In Russian)

The nonlinear theory of plasma oscillations is investigated. Self-similar solutions are found for a nonlinear equation describing the evolution of plasma waves in the absence of a pumping wave, and based on these solutions, the possibility of wave "collapse" is examined in two- and three-dimensional cases, depending on the degree of symmetry of the initial conditions. The influence of phase mixing on the interaction of plasma turbulence with a pumping wave is investigated, and the turbulence spectrum is obtained on the basis of Kolmogorov's hypothesis assuming that Langmuir wave collapse is the basic process of scale fractionation. (IAA)

20030 PARAMETRIC EXCITATION OF A FAST MAGNETOSONIC WAVE AND FAST ELECTRONS IN A PLASMA. Pasechrik, L. L.; Pustovalov, V. V.; Semeniuk, V. F.; Silin, V. P.; Tikhonchuk, V. T. (Physics Inst., Moscow). Fiz. Plazmy; 1: 21-27(1975). (In Russian)

A detailed comparison is presented of theoretical and experimental results for parametric turbulence caused by decay excitation of a high-speed magnetosonic wave and oscillations at the lower hybrid resonance frequency in a magnetically active plasma. A series of experiments and detected phenomena are described, and the latter are explained on the basis of the quasi-linear theory of parametric turbulence and the theory of parametric turbulence in a plasma allowing for the finite length of the pumping wave. The theoretical and experimental results are found to be in good qualitative and quantitative agreement. It is concluded that the detected parametric instability is associated with the decay of the pumping wave to a lower hybrid oscillation and a fast magnetosonic wave, and that this instability becomes stabilized because of a quasi-linear effect of the redistribution of plasma particles by velocity, leading to the generation of fast electrons. (IAA)

20031 THREE-DIMENSIONAL SOLITONS OF EXTRAORDINARY AND LANGMUIR WAVES. Petviashvili, V. I. (Inst. of Atomic Energy, Moscow). Fiz. Plazmy; 1: 28-31(1975). (In Russian)

Stationary three-dimensional soliton packets are found for Langmuir and slow extraordinary waves in a weakly magnetic plasma by means of classical plasmon equations. It is shown that such soliton packets will exist and not diffuse in an infinite medium because of the nonlinearity and anisotropy of dispersion in the plasma. (IAA)

20032 THERMAL SELF-INTERACTION OF WAVE BEAMS IN A PLASMA WITH NONLOCAL NONLINEARITY. Litvak, A. G.; Mironov, V. A.; Fraiman, G. M.; Yunakovskii, A. D. (Scientific-Research Radiophysics Inst., Gorky, USSR). Fiz. Plazmy; 1: 60-71(1975). (In Russian)

The steady self-interaction of quasi-optical wave beams is investigated in a weakly ionized plasma where nonlinear effects of heating and ionization are the determining factors. A nonaberrational approximation is derived which describes thermal self-interaction of a beam, and the quantitative characteristics are obtained for the self-focusing of axisymmetric beams. The instability where a wide wave beam is divided into narrower beams under conditions of nonlocal nonlinearity is analyzed in an example of a homogeneous plane wave in a plasma with nonlocal temperature perturbations, and the influence of reflected beams on this instability process is discussed. The influence of ionization effects on propagation of wave beams is analyzed in the cases where the local field function is either temperature or pressure, and the evolution of a beam under these conditions is described. (IAA)

20033 MODULATED BEAMS IN CYCLOTRON OSCILLATIONS IN THE AC INSTALLATION. Zhukovskii, V. G.; Timofeev, A. V. (Inst. of Atomic Energy, Moscow). Fiz. Plazmy; 1: 111-113 (1975). (In Russian)

The excitation of modulated beams in the presence of plasma cyclotron oscillations is experimentally demonstrated, and the results are shown to confirm theoretical representations of the mechanism of energy exchanges between self-consistent oscillations and a collisionless plasma during cyclotron resonance in an inhomogeneous magnetic field. The AC installation is described, and the spatial structure of the oscillations is measured. The results show that two wave processes with the same frequency and different spatial processes occur and are analogous to Van Kampen waves, except that charge clusters formed by the beams have a spiral motion. The oscillations are found to be waves escaping from a resonance point, and their frequency is equal to the frequency of the fundamental wave. (IAA)

20034 PARAMETRIC EXCITATION OF DRIFT-CYCLOTRON WAVES IN AN INHOMOGENEOUS PLASMA WITH TWO ION SPECIES. Kitsenko, A.B.; Klima, R.; Panchenko, V.I.; Stepanov, K.N. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 20: No. 4, 453-457 (Apr 1975).

A study is made of the parametric excitation of drift-cyclotron waves in an inhomogeneous plasma containing two ion species in a homogeneous alternating electric field with frequency ω_0, where ω_0 is of the order of the ion cyclotron frequency ω_{Bi}. It is shown that the inhomogeneity of the plasma is important in a weak pump field when $u < v_{Ti}(\rho_i/a)$ (u is the velocity of relative motion of the ions in the field of the pump wave, v_{Ti} and ρ_i are the ion thermal velocity and Larmor radius, and a is the characteristic inhomogeneity scale of the plasma). Under these conditions, the most unstable modes have frequencies of the order of the drift frequency; the growth rates are smaller than those for a homogeneous plasma. (auth)

20035 TIME EVOLUTION OF WAVE CONVERSION IN A HIGHLY INHOMOGENEOUS ISOTROPIC PLASMA. Davydova, T.A. (Institute of Nuclear Research, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Phys.—Tech. Phys. 20: No. 4, 471-473 (Apr 1975).

It is shown that the conversion of electromagnetic and plasma waves can be reversible in an inhomogeneous nondissipative isotropic plasma with a perfectly conducting surface parallel to the boundary of the plasma. (auth)

20036 PARAMETRIC EXCITATION OF LOW-FREQUENCY PLASMA OSCILLATIONS IN A MAGNETIC FIELD. Pasechnik, L.L.; Semenyuk, V.F. (Institute of Nuclear Research, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Phys.—Tech. Phys. 20: No. 4, 491-493 (Apr 1975).

In an experimental study of the parametric instability of a magnetized plasma in a spatially periodic rf field it has been found that raising the pump field causes a pronounced change in the plasma-oscillation spectrum. The nature of the waves changes qualitatively: Instead of the fast acoustic wave which is excited under decay conditions, a slow acoustic wave appears, excited parametrically when $\gamma \sim \omega$ (γ is the growth rate and ω is the frequency). The growth rates were measured in both cases and studied as a function of the time. For the case of the fast acoustic wave this time dependence agrees with that reported earlier by Pustovalov *et al.* for the quasilinear relaxation of the decay instability. (auth)

20037 LAUNCHING OF ELECTROMAGNETIC WAVES IN A MAGNETIZED PLASMA BY A SYSTEM OF NARROW SHIELDS.

Longinov, A.V.; Miroshnichenko, G.A. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 20: No. 4, 517-520 (Apr 1975).

The launching of slow and ion-acoustic waves in a magnetized plasma by a system of narrow shields is analyzed. The results of numerical calculations for a particular system are reported. (auth)

20038 EFFECT OF AND RF FIELD ON SURFACE OSCILLATIONS OF A WEAKLY IONIZED MAGNETOACTIVE PLASMA. Starodub, A.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Tech. Phys. 20: No. 4, 564-565 (Apr 1975).

The effect of an rf electric field, $E(t) = E_0 \sin \omega_0 t$, on the surface oscillations of a weakly ionized plasma in a magnetic field, B, is studied. It is shown that low-frequency surface oscillations, whose frequency is below the ion plasma frequency, can be stabilized in a sufficiently large rf field. (auth)

20039 EIGENMODES OF A COLD PLASMA IN A TIME-VARYING MAGNETIC FIELD. Avrov, A.I.; Smolyanskii, S.A. (N. G. Chernyshevskii Saratov State University). Sov. Phys.—Tech. Phys. 20: No. 4, 566-567 (Apr 1975).

Beginning with the equation for the mean electron velocity we find the electrical conductivity tensor for rarefied, nonrelativistic, cold plasma in a spatially uniform, time-varying magnetic field. The dispersion relations are obtained for the case of transverse plasma oscillations in a strong magnetic field. Analysis leads to the conclusion that new oscillatory modes arise due to a time-varying magnetic field but that these are stable for all the cases examined here. (auth)

20040 RESISTIVE INTERCHANGE QUASI-MODES IN A PLASMA CYLINDER. Dagazian, R.Y. (Association EURATOM-CEA sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, 92260 Fontenay-aux-Roses, France). Phys. Fluids 19: No. 1, 169-170 (Jan 1976).

A resistive interchange quasi-mode is derived in a cylindrical magnetically confined plasma. (auth)

20041 INSTABILITY AS A SOURCE FOR TRAVELING ION WAVES. Sato, N.; Popa, G.; Märk, E.; Mravlag, E.; Schrittwieser, R. (Institute for Theoretical Physics, Innsbruck University, A-6020 Innsbruck, Austria). Phys. Fluids 19: No. 1, 70-73 (Jan 1976).

Low-frequency instability is excited by passing a dc electron current in a collisionless Q-machine plasma. The current is driven by applying a positive bias to a grid situated between the hot plate and the cold end plate. The instability shows a standing-wave pattern between the hot plate and the grid. The frequency can be controlled by varying the hot plate-grid separation. This instability is used as a source for excitation of traveling waves behind the grid. The excited waves have the same dispersion relation as ion waves excited by applying external signals to the grid. (auth)

20042 PARTICLE MOTION IN ION CYCLOTRON WAVE FIELDS. Liemohn, H.B.; Duane, B.H. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington 99352). Am. J. Phys. 44: No. 1, 100-103 (Jan 1976).

The interaction between charged particles and circularly polarized electromagnetic waves propagating parallel to a static magnetic field is an important problem in classical plasma physics owing to possible energy exchange at the cyclotron resonance. The nonlinear motion of ions in such fields is known to be described by elliptic functions, but the physics is obscured by the complicated expressions. The properties of the particle trajectories are much more transparent in the perturbation–expansion solution derived here. For small wave amplitudes the solutions are valid for an extended time and the resonance effects are clearly evident. The initial phase between the particles and wave fields emerges as an important condition on the motion. Potential applications of the results in magnetospheric physics and plasma fusion devices are briefly discussed. (auth)

20043 AN APPLICATION OF THE METHOD OF GEOMETRICAL OPTICS TO THE SCATTERING OF PLANE ELECTROMAGNETIC WAVES OFF CYLINDRICALLY CONFINED COLD PLASMAS. Kriegsmann, G.A. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). J. Math. Phys. (N.Y.) 17: No. 1, 112-120 (Jan 1976).

In this paper we apply the method of geometrical optics to study the scattering of plane electromagnetic waves off a cylindrically confined cold plasma. For simplicity, we assume two types of incident polarization. In both cases scalar second order elliptic partial differential equations describe the fields. These problems are studied in the asymptotic limit $a\omega/c \to \infty$ (where a is the radius of the cylinder, ω is the frequency of the incident plane wave, and c is the velocity of light in free space). We furthermore assume a quadratic plasma density. This allows us to calculate explicitly the rays, amplitudes, caustics, and other features which arise in the geometrical optics approach. The assumed density also gives rise to the interesting cutoff and resonance phenomenon. Thus the amplification of the electromagnetic fields is observed. This phenomenon may have applications in laser fusion. (auth)

20044 NONLINEAR WAVENUMBER OF AN ELECTRON PLASMA WAVE. Vidmar, P.J.; Malmberg, J.H.; Starke, T.P. (Department of Physics, University of California at San Diego, La Jolla, California 92037). Phys. Fluids 19: No. 1, 32-42 (Jan 1976).

The wavenumber of a large-amplitude electron plasma wave propagating on a collisionless plasma column is measured. The wavenumber is shifted from that of a small-amplitude wave of the same frequency. This nonlinear wavenumber shift, δk_r, depends on position, frequency, and initial wave amplitude, Φ. The observed spatial oscillations of δk_r agree qualitatively with recent theories. Experimentally $\delta k_r \propto k_i S(\Phi)\sqrt{\Phi}$ where k_i is the linear Landau damping coefficient, $S(\Phi) \equiv k_i(\Phi)/k_i$, and $k_i(\Phi)$ is the initial damping coefficient which depends on Φ. (auth)

20045 THEORY OF INTENSE ION BEAM ACCELERATION. Antonsen, T.M. Jr.; Ott, E. (Department of Electrical Engineering, Cornell University, Ithaca, New York 14853). Phys. Fluids 19: No. 1, 52-59 (Jan 1976).

The application of high voltage pulse power techniques to the production of intense ion beams is of great interest for plasma confinement, plasma heating, and pellet implosion. The main problem is that application of a high voltage to a simple anode–cathode gap will draw both an electron current from the cathode and an ion current from the anode, and the electrons will receive most of the input energy due to their smaller mass. Two methods of efficient intense ion beam production are considered: (1) the magnetically insulated diode and (2) the "reflex-triode". The relativistic equilibria, the ion current dependence on accelerating voltage, its dependence on applied magnetic field (in the first method), and its variation due to a velocity distribution of the electrons (in the second method) are determined. For both methods the ion current can be substantially enhanced with respect to the Langmuir–Child current due to the presence of the negative electron space charge. In the case of magnetic insulation this enhancement increases as the magnetic field is lowered and diverges as it approaches the critical value past which electrons can traverse the gap. For the reflex triode the enhancement is increased by relativistic electron effects and by a population of electrons with energies less than the full voltage across the gap. (auth)

20046 OSCILLATION-CENTER FORMULATION OF THE CLASSICAL THEORY OF INDUCED SCATTERING IN PLASMA. Johnston, S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 19: No. 1, 93-107 (Jan 1976).

Particle trapping in the beat potential produced by the mixing of two coherent waves lies outside the domain of the conventional weak-turbulence theory of induced wave–particle scattering in plasma. A reformulation of the theory is presented which is applicable to this extended domain. The formulation is based upon a canonical transformation to "oscillation-center variables" and in particular affords a simpler method for deriving the "linear" matrix elements of weak-turbulence theory. This method is first illustrated in the problem of the nonlinear Landau damping of longitudinal plasma modes. The power of the method is then usefully exploited in two more difficult situations, namely, the cases of electrostatic waves in the presence of a uniform magnetic field, and electromagnetic waves in an arbitrarily relativistic plasma. The application of the transformation to the extended strong-interaction regime is demonstrated. (auth)

20047 ATTENUATION OF ELECTRON WAVES ON DRIFTING PLASMAS. Anicin, B. A.; Babovic, V. M. (Boric Kidric Inst. of Nuclear Sciences, Belgrade). Fizika (Zagreb); 7: No. 2, 71-82 (Jun 1975).

Measurements of electron waves attenuation on drifting plasmas are described. The results are given for mercury pool temperatures of 10°, 15°, and 20°C. From the theoretical point of view various physical mechanisms leading to damping are described: collisional loss due to electron-atom collisions, collisionless Landau damping and dielectric loss in the discharge tube walls. The total attenuation coefficient is derived as a sum of the various contributing effects. Comparison of theory and experimental data is presented. (auth)

20048 CANONICAL MOMENTA AND NUMERICAL INSTABILITIES IN PARTICLE CODES. Godfrey, B. B. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 19: No. 1, 58-76(Sep 1975).

A set of warm plasma dispersion relations appropriate to a large class of electromagnetic plasma simulation codes is derived. The numerical Cherenkov instability is shown by analytic and numerical analysis of these dispersion relations to be the most significant nonphysical effect involving transverse electromagnetic waves. The instability arises due to a spurious phase shift between resonant particles and light waves, caused by a basic incompatibility between the Lagrangian treatment of particle positions and the Eulerian treatment of particle

velocities characteristic of most PIC–CIC algorithms. It is demonstrated that, through the use of canonical momentum, this mismatch is alleviated sufficiently to completely eliminate the Cherenkov instability. Collateral effects on simulation accuracy and on other numerical instabilities appear to be minor. (auth)

20049 RADIATION AND RECEPTION CHARACTERISTICS OF AN ELECTRON PLASMA WAVE FROM GRID ANTENNAS HAVING A dc BIASED PARASITIC GRID. Ohnuki, S.; Ohnuma, T.; Adachi, S. (Tohoku Univ., Sendai). Int. J. Electron.; 39: No. 4, 385-392 (Oct 1975).

The radiation and reception characteristics of an electron plasma wave from closely spaced double grids, one of which is a dc biased parasitic grid (unfed by rf signal), are investigated experimentally. As a result, it is found that the radiation and reception with high efficiency of an electron plasma wave are enhanced by about 50% by the presence of the parasitic grid with a floating dc potential. The directional radiation and reception patterns of this antenna can also be made unidirectional with an increased radiation and reception efficiency by about 20% by the appropriately biased parasitic grid. (auth)

20050 NONSTATIONARY PROPAGATION OF A GAUSSIAN ELECTROMAGNETIC PULSE IN A DECAYING/GROWTH PLASMA. Kaushik, S. C.; Sen, R. (Indian Inst. of Tech., New Delhi). J. Phys., D (London); 8: No. 16, 1975-1981(11 Nov 1975).

The propagation of a Gaussian electromagnetic pulse in a growing/decaying (time-dependent) plasma has been studied when the duration of the pulse is comparable with the decay/growing time of the plasma. Because of the different group velocities of the front and tail portions of the pulse, the pulse is compressed/broadened in a time-dependent plasma. The effect of absorption on the compression/broadening is found to be negligible. However, the peak value of the pulse is suppressed by attenuation. (auth)

20051 TOEPLITZ MATRIX APPLICATION: A DIPOLE IN A WARM PLASMA. Lytle, R. J.; Lager, D. L. (Univ. of California, Livermore). Radio Sci.; 10: No. 10, 905-909(Oct 1975).

A linear dipole antenna has an impedance matrix of Toeplitz form. The problem of an acoustically long cylindrical antenna in a warm plasma thus becomes numerically tractable. Both the electromagnetic and acoustic wavelengths are evident in the current distribution for acoustically long antennas. Relative accuracies of 10^{-11} were obtained for inversion of a 5000 x 5000 complex impedance matrix, including both electromagnetic and acoustic contributions. Antennas up to 500 acoustic wavelengths long are considered in numerical examples. (auth)

ENGINEERING

20052 ENERGY REQUIREMENTS AND FEDERAL POLICY ACTIONS. Hanrahan, E. J.; Williamson, R. H. (Energy Research and Development Administration, Washington, DC). Trans. Am. Nucl. Soc.; 22: 544-545(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20053 IMPORTANCE OF RATE REFORM AND LOAD MANAGEMENT. Bauer, D. C. (Federal Energy Administration, Washington, DC). Trans. Am. Nucl. Soc.; 22: 545-546(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20054 DESIGN OF THE HIGH-TEMPERATURE SODIUM FACILITY LARGE-COMPONENT HANDLING SYSTEM. Tome, R. L.; Matsuo, R.; Woodfill, W. H. (Aerojet Manufacturing Co., Fullerton, CA). Trans. Am. Nucl. Soc.; 22: 764(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Energy Conversion

Refer also to abstract 20365.

Facilities and Equipment

Refer also to abstracts 21951, 22044, and 22123.

20055 (CNLM-1870) PRELIMINARY DESIGN CRITERIA FOR CANEL FUEL ELEMENT SHOP. MacFarlane, D. B. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 25 Aug 1959. 35p. Dep. NTIS $4.00.
The experimental program being conducted at CANEL requires the construction of a fuel element shop. The purpose of the shop is to provide space and facilities for storing and processing raw materials, and assembling and inspecting reactor fuel elements. The size of the facility was determined from a study of the requirements of the CANEL program. The process and the equipment design are based on operating experience and the results of experimental work in the existing small scale fuel element facility. The report describes the facility and the function of each area. It presents the general design considerations and gives specific design criteria where this is possible. Contractor supplied building equipment is described and Pratt & Whitney Aircraft provided process equipment is listed where it affects building design. (auth)

20056 (SAND-74-0086) SANDIA LABORATORIES TECHNICAL CAPABILITIES: ELECTRONICS. Lundergan, C. D. (Ed.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 17p. Dep. NTIS $3.50.
This report characterizes the electronics capabilities at Sandia Laboratories. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

20057 (SAND-74-0087) SANDIA LABORATORIES TECHNICAL CAPABILITIES: ENGINEERING ANALYSIS. Lundergan, C. D. (Ed.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 55p. Dep. NTIS $4.50.
This report characterizes the engineering analysis capabilities at Sandia Laboratories. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

20058 (SAND-74-0088) SANDIA LABORATORIES TECHNICAL CAPABILITIES: TESTING. Lundergan, C. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT (29-1)-789. 36p. Dep. NTIS $5.00.
The testing capabilities at Sandia Laboratories are characterized. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

Lasers

Refer also to abstracts 20812, 21205, and 21255.

20059 (ONERA-NT-216) FLOW WITH VIBRATIONAL ENERGY EXCHANGE AND APPLICATION TO ELECTRIC CO_2 LASERS. Dahan, C. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92-Chatillon (France)). 1974. 82p. (In French). Dep. NTIS (US Sales Only) $5.00.
Thesis.
The performance of a continuous wave (CO_2, N_2, He) laser ionized by an electron beam is calculated. Several types of phenomena are considered, i.e., (1) energy exchange processes between molecules of laser medium; (2) electron molecular excitation processes; and (3) aerodynamic phenomena, the energy exchanges accompanying the laser effect generate important quantities of heat, which have to be evacuated by the flow. After a survey of the fundamental assumptions on molecular phenomena, a computer code was developed for following, along with the flow, the evolution of the thermodynamic parameters (pressure, temperature), of the laser gain, and of the electrical properties (electron density and temperature). To provide a finer description, a model giving the energy distribution of the electrons in the laser medium was established. Emphasis is made on two possible limitations: (1) at subsonic regimes in the nozzle, an electric breakdown occurs when the ratio of electric field to neutral particle density rises too much; and (2) at supersonic regimes, a sonic blockage arises. (auth)

20060 (UCRL-Trans-10749) PREPARATION OF A LASER AMPLIFIER REACHING A POWER OF 50 MW AT 3371 A IN MOLECULAR NITROGEN. Girardeau-Montaut, J. P.; Roumy, M.; Hamelin, J.; Avan, L. Translated from C. R. Hebd. Seances Acad. Sci., Ser. B; 274: 607-610(28 Feb 1972). 7p. $3.50.
A new series of experiments on transverse electronic pumping of molecular nitrogen permitted the obtaining of an emission power close to 50 MW at 3371 A. From the results obtained with the two laser cells, of 1 m and 0.5 m in length, the gain in amplification was evaluated at 20 dB. The duration of the emission is of the order of 2 ns. (auth)

20061 (UCRL-Trans-10750) CALCULATION OF THE TOTAL POWER EMITTED AT 3,371 A BY A PULSED N_2 LASER WITH TRANSVERSE EXCITATION. Gerardeau-Montaut, J. P.; Girardeau-Montaut, C. Translated from C. R. Hebd. Seances Acad. Sci., Ser. B; 274: 740-743(13 Mar 1972). 7p. Dep. NTIS $3.50.
The calculation of the total power emitted at 3371 A by a pulsed molecular nitrogen laser was made. The main steps of the process are given and numerous points of the method proposed first by Jerry then by Ali, Kolb and Anderson were adapted to this particular case. The result was compared to the signal observed by means of a photodiode under identical experimental conditions. (auth)

20062 (UCRL-Trans-10751) PULSATED MOLECULAR NITROGEN LASER EMITTING ULTRAVIOLET. Girardeau-Montaut, J. P.; Roumy, M.; Hamelin, J.; Avan, L. Translated from C. R. Hebd. Seances Acad. Sci., Ser. B; 273: 725-728(18 Oct 1971). 8p. Dep. NTIS $3.50.
A laser effect was obtained in molecular nitrogen by electronic pumping. The emission wave length is 3371 A and corresponds to the transition $C^3\Pi$/sub u/ yields $B^3\Pi$/sub g/ of the second positive band. The power emitted is in the vicinity of 10 kW and the light impulse has a duration of about 5 ns. (auth)

20063 KINETIC MODEL FOR OPTICALLY PUMPED LASERS USING ELECTRONIC TRANSITIONS OF NOBLE GAS MOLECULES. Skorobogatov, G.A. (A. A. Zhdanov Leningrad State University). Sov. Phys.—Tech. Phys. 20: No. 4, 521-524 (Apr 1975).
A kinetic model is constructed for a hypothetical laser using the transition $Xe_2(^3\Sigma^+_u)+h\nu_{gen}$ (~147 nm) $Xe_2(^1\Sigma^+_g)+2h\nu_{gen}$ which is optically pumped in the process $2Xe(^1S_0)+h\nu$ (~175 nm) $\rightarrow Xe_2(^1\Sigma^+_u) \rightarrow Xe_2\cdot(^3\Sigma^+_u)$. The lower level is depopulated in the fast reaction $Xe_2(^1\Sigma^+_g) \rightarrow 2Xe(^1S_0)$. An analytic solution is found for the kinetic equations, and numerical estimates are given. (auth)

20064 SPONTANEOUS AND STIMULATED EMISSION OF NEODYMIUM IN LEAD FLUOPHOSPHATE CRYSTALS. Morozov, A.M.; Morozova, L.G.; Fedorov, V.A.; Feofilov, P.P. Opt. Spectrosc. (USSR) 39: No. 3, 343-344 (Sept 1975).
Luminescence spectra of $Pb_5(PO_4)_3F$ crystals activated with netodymium are reported. Lasing characteristics of these crystals are studied.(AIP)

20065 INVESTIGATION OF SOME SPECTRAL AND ENERGY CHARACTERISTICS OF THE LASING OF A NUMBER OF COUMARIN DERIVATIVES. Dzyubenko, M.I.; Vodotyka, G.S.; Maslov, V.V.; Nikitchenko, V.M. Opt. Spectrosc. (USSR) 39: No. 3, 310-311 (Sept 1975).
Fifteen lasing coumarin derivatives with substitutions of a different electronic nature in the 3,4,5,6, and 7 positions of the coumarin ring when excited by the second harmonic of a ruby laser are investigated. Emission from these compounds is obtained in a nonselective resonator

in the range from 410 nm to 500 nm when using different solvents and variations in their acidity. It is found that the most efficient compounds are those that contain the electron-donor substitution, the diethylamino group, in position 7. (auth)

20066 INTERMOLECULAR INTERACTIONS AND INDUCED-EMISSION SPECTRA OF LIQUID ACTIVATED SYSTEMS. 5: INFLUENCE OF THE SOLVENT ON THE LASING THRESHOLD OF RHODAMINE 6G. Smirnov, V.S.; Zabiyakin, Y.E.; Bakhshiev, N.G. Opt. Spectrosc. (USSR) 39: No. 3, 312-314 (Sept 1975).

A quantitative study was carried out on the effect of the solvent on the spectroscopic (absorption and fluorescence spectra) and lasing (lasing frequency and threshold) characteristics of rhodamine 6G with lamp pumping. It was demonstrated that intermolecular relaxation processes play an important role in the variation of the said characteristics, thus indicating the need for considering these processes when interpreting both the spontaneous and induced emission spectra of solutions of rhodamine 6G and related compounds. (auth)

20067 LUMINESCENCE AND INDUCED EMISSION LITHIUM-ERBIUM AND LITHIUM-HOLMIUM BINARY FLUORIDES. Morozov, A.M.; Podkolzina, I.G.; Tkachuk, A.M.; Fedorov, V.A.; Feofilov, P.P. Opt. Spectrosc. (USSR) 39: No. 3, 338-339 (Sept 1975).

The luminescent and lasing characteristics of two new crystals, $ErLiF_4$ and Ho_3LiF_3 are investigated.(AIP)

20068 POLARIZATION FREQUENCY SELECTORS FOR LASERS WITH THERMALLY DEFORMED ACTIVE ELEMENTS. Novikov, M.A. Opt. Spectrosc. (USSR) 39: No. 3, 341-342 (Sept 1975).

Birefringent polarization prisms are used as frequency selectors for solid state lasers. Various arrangements of the selectors are described.(AIP)

20069 ROTATIONAL TEMPERATURE IN A HIGH-PRESSURE PULSED CO_2 LASER. Leland, W. T.; Kircher, M. J.; Nutter, M. J.; Schappert, G. T. (Los Alamos Scientific Lab., NM). J. Appl. Phys.; 46: No. 5, 2174-2176(May 1975).

Small-signal gain at line center for a group of lines has been utilized to deduce the time dependence of rotational temperature in pulsed high-pressure CO_2 laser systems. Attempts to extract additional information on excited-state population densities are compromised by uncertainties in the vibration-rotation interaction. Anomalies in the small-signal gain for the P20, P28, and R14 lines of the 10.4-mu band are observed. (auth)

20070 INTEGRATED AND FIBER OPTICAL DEVICES AND SYSTEMS. Giallorenzi, T. G.; Weller, J. F. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2440-2447(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A state of the art review is presented on fiber optic systems and integrated optical devices. Advantages of such systems, problem areas, and applications are discussed. (auth)

20071 BEAT FREQUENCY BETWEEN TWO AXIAL MODES OF A He-Ne LASER WITH INTERNAL MIRRORS AND ITS DEPENDENCE ON CAVITY *Q*. Balhorn, R.; Lebowsky, F.; Ullrich, D. (Physikalisch-Technische Bundesanstalt, 33 Braunschweig, West Germany). Appl. Opt. 14: No. 12, 2955-2959 (Dec 1975).

Differences of the beat frequencies of a He-Ne laser in two-frequency operation up to 1.8 MHz in the two different states of polarization are observed. These differences of the beat frequencies are explained by the dependence of the beat frequency on the cavity Q, using Lamb's theory. A method of measuring the cavity Q of a passive laser resonator as a function of the direction of polarization of the external exciting radiation is described. The linear dependence of the difference of the beat frequencies $\Delta f_{II,I}$ and $\Delta f_{II,I}$ from the difference of the reciprocal values of the cavity Q factors $1/Q_{II}$ and $1/Q_I$, derived from Lamb's theory for the simple case of midtuning, is proved qualitatively by experiments. (auth)

20072 EFFECT OF CAVITY TRANSIENTS AND ROTATIONAL RELAXATION ON THE PERFORMANCE OF PULSED HF CHEMICAL LASERS: A THEORETICAL INVESTIGATION. Hough, J.J.T.; Kerber, R.L. (Michigan State University, East Lansing, Michigan, 48824). Appl. Opt. 14: No. 12, 2960-2970 (Dec 1975).

Two rate-equation models of a pulsed HF laser are presented. Calculations with these models reveal the time evolution of the gain and intensity of lasing on all lines in vibrational-rotational bands studied and the time histories of concentrations of the chemical species. The present formulation permits an accurate assessment of the effect of vibrational relaxation and rotational relaxation. The model predictions are compared with earlier models to illustrate their unique features. Multiline lasing on vibrational-rotational bands is predicted; however, the general trends of J shifting are similar to those of earlier models. It is found that lasing does not begin when the medium gain reaches threshold, but intensity increases sharply after the gain is far above threshold. The gain subsequently drops rapidly and oscillates near the threshold value. The effect of rotational relaxation on laser performance is shown for multiline laser operation, and the enhancing effect of cascading is clearly revealed. The present models are found to predict output and performance consistent with experiment. (auth)

20073 CONSTANT PULSE ENERGY POWER SUPPLY FOR A HIGH REPETITION RATE LASER SYSTEM. Lo, C.C.; Fan, B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Rev. Sci. Instrum. 47: No. 1, 63-65 (Jan 1976).

A pulsed power supply system with constant pulse energy has been developed to drive flashlamps in a 0.5–5 pulses per second Nd : glass laser. By using a stable, absolute reference voltage source to set the trigger level, the energy discharged through the flashlamps is kept constant despite pulsing frequency change, power line fluctuation, and minimum dc power supply regulation. The concept can be expanded or adapted to operate other similar systems. (auth)

20074 SIMPLE FAST-DISCHARGE DEVICE FOR HIGH-POWER PULSED LASERS. Wang, C.P. (The Aerospace Corporation, El Segundo, California 90245). Rev. Sci. Instrum. 47: No. 1, 92-95 (Jan 1976).

A fast-discharge device that is volume scalable, capable of a high pulse-repetition rate, and simple in construction is described. The device has two novel features: (1) it is assembled within a vacuum chamber so that atmospheric pressure is used to compress a parallel-plate transmission line, and (2) it utilizes multiple transmission lines to provide increased lasing volume. This device is useful for generating laser action in N_2, H_2, and Ne, and for pumping many other self-terminating lasers, such as metal vapor lasers and dimer lasers. Its discharge characteristics and its performance as a N_2 laser are discussed. (auth)

20075 RADIAL PROFILES OF UPPER-LASER-LEVEL EMISSION IN AN OSCILLATING Ar II LASER. Ihjima, T.; Karatsu, O.; Ogura, I. (Institute of Industrial Science, University of Tokyo, Roppongi, Minatoku, Tokyo, Japan). J. Appl. Phys. 47: No. 1, 383-384 (Jan 1976).

Radial profiles of the emission from upper-laser-level ions have been investigated in an oscillating Ar II laser and a significant dip in the tube center is observed. (auth)

20076 INNER-SHELL PHOTOIONIZATION-PUMPED X-RAY LASERS. SULFUR. Axelrod, T.S. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. A 13: No. 1, 376-382 (Jan 1976).

The potential for use of inner-shell vacancies produced by photoionization for creation of an x-ray laser is discussed. A detailed numerical model of the physical processes involved is described and applied to sulfur, one of the most favorable materials for production of x-ray lasing at energies substantially greater than 1 keV. At solid density an x-ray pumping power of 1.7×10^{16} W/cm^2 is required with a rise time of less than 5 fsec, while at very low densities the rise-time requirement relaxes to about 50 fsec. The difficulties of meeting these requirements with current technology are discussed briefly. (auth)

20077 ELECTRON-BEAM-CONTROLLED N_2 INFRARED LASER. Newman, L.A.; DeTemple, T.A. (Electro-Physics Laboratory, Department of Electrical Engineering, University of Illinois, Urbana, Illinois 61801). J. Appl. Phys. 47: No. 1, 376-377 (Jan 1976).

Laser action in N_2 on the first positive system ($B^3\Pi_g \rightarrow A^3E^+_u$) has been obtained in an electron-beam-controlled discharge. Pressures of up 200 Torr (limited by the sustainer voltage available) were used resulting in a maximum output of 30-kW 2-mJ pulses at an efficiency of 0.01%. The addition of a small amount ($\sim$1 Torr) of SF_6 resulted in a doubling of the output power and energy. (auth)

20078 FREQUENCY STABILITY OF A CW HF CHEMICAL LASER. Wang, C.P. (The Aerospace Corporation, El Segundo, California). J. Appl. Phys. 47: No. 1, 221-223 (Jan 1976).

A new scheme for measuring the frequency stability of a cw HF chemical laser is described. It is based on the measurement of the beat-frequency spectrum of longitudinal modes and the mode-pulling effect in a high-gain medium. The mode-pulling effect can also be used to actively stabilize the laser frequency. Experimental measurements on the mode pulling and the stability of a free-running cw HF chemical laser agree with theory and other experimental measurements. (auth)

20079 SHAPE AND STABILITY DEPENDENCE OF PASSIVELY MODE-LOCKED PULSES ON ABSORBER RELAXATION TIME. Hagelstein, P.L.; Ausschnitt, C.P. (Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Appl. Phys. 47: No. 1, 224-228 (Jan 1976).

The dependence of the saturable absorber mode-locked pulse shape upon the relaxation time of the absorber is determined when the laser

gain is assumed constant. The pulses are found to be asymmetric with a slowly rising edge and a more rapidly decaying edge. The mode-locked pulse width is a weak function of absorber relaxation time T_A, becoming broader with increasing T_A. Furthermore, the pulses are found to experience a delay in traversing the absorber which lengthens the cavity transit time. The growth of perturbations introduced into the steady state is shown to be bounded, indicating that stable mode-locked operation is possible even in cases where T_A is comparable to or greater than the width of the steady-state pulse. (auth)

20080 STIMULATED EMISSION IN GALLIUM PHOSPHIDE EXCITED BY TWO-PHOTON OPTICAL PUMPING. Adduci, F.; Catalano, I.M.; Cingolani, A.; Minafra, A. (Istituto di Fisica dell'Università, Bari, Italy). J. Appl. Phys. 47: No. 1, 229-231 (Jan 1976).

The luminescence properties of GaP (Te) have been investigated under strong optical pumping by a ruby laser (two-photon excitation) at 80 °K. Stimulated emission is observed at 5413 Å with a pumping threshold of 13 MW/cm². Gain measurements at various intensities are also reported. (auth)

20081 CONTINUOUS-WAVE OPERATION OF Nd : YVO_4 AT 1.06 AND 1.34 μ. Tucker, A.W.; Birnbaum, M.; Fincher, C.L. (Electronics Research Laboratory, The Aerospace Corporation, El Segundo, California 90245); DeShazer, L.G. J. Appl. Phys. 47: No. 1, 232-234 (Jan 1976).

Continuous-wave plane-polarized outputs of 1 W at 1.06 μ and 0.35 W at 1.34 μ were obtained by end pumping small samples of Nd : YVO_4 with an argon-ion laser. Slope efficiencies and material losses were determined. At 1.06 and 1.34 μ, Nd : YVO_4 lasers can substantially outperform Nd : YAG lasers. Self-Q-switched operation of Nd : YVO_4 at both wavelengths was obtained by resonator misalignment. (auth)

20082 FORMATION OF ULTRASHORT PULSES IN DYE LASERS WITH SATURABLE ABSORBERS. Yasa, Z.A.; Teschke, O.; Braverman, L.W. (Electronics Research Laboratory, University of California, Berkeley, California 94720). J. Appl. Phys. 47: No. 1, 174-176 (Jan 1976).

Passive mode locking of dye lasers is studied with the inclusion of the relaxation times. An equation derived for the integrated gain coefficient is used to explain the shortening mechanism in the long pulse stage in which gain saturation is shown to have an emphasized role in the compression of the trailing edge. (auth)

20083 CW TUNABLE LASER-SIDEBAND GENERATION FROM 5.5 TO 6.5 μM BY LIGHT SCATTERING FROM SPIN MOTION IN A SPIN-FLIP RAMAN LASER. Nguyen, V.T.; Burkhardt, E.G. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Appl. Phys. Lett. 28: No. 4, 187-189 (15 Feb 1976).

We have succeeded in generating cw laser sidebands at wavelengths tunable from ~5.5 to ~6.5 μm. The behavior of the power output of the generated radiation is described quantitatively by using the equivalence between four-photon mixing and Raman scattering from coherent spin motion in a spin-flip Raman laser. (auth)

20084 LASER PERFORMANCE OF LARGE ND-PENTAPHOSPHATE CRYSTALS. Gualtieri, J.G. (Combat Surveillance and Target Acquisition Laboratory, United States Army Electronics Command, Fort Monmouth, New Jersey 07703); Aucoin, T.R. Appl. Phys. Lett. 28: No. 4, 189-192 (15 Feb 1976).

Laser performance of twinned 90% Nd–10% Y-pentaphosphate (0.9 Nd–0.1 YP_5O_{14}) crystals with dimensions typically 4.5×3 mm in diamond-shaped cross-section by 2 mm thick is reported. Power conversion efficiencies of ≃24% and peak power outputs of approximately 240 mW were obtained under optical excitation with a repetitively pulsed argon laser. Samples of 0.75 Nd–0.25 InP_5O_{14}, 0.1 Nd–0.9 YP_5O_{14}, 0.1 Nd–0.9 CeP_5O_{14}, and 0.1 Nd–0.9 GdP_5O_{14} were also lased. (auth)

20085 OPTICAL GAIN IN A NEUTRON-INDUCED ^{3}He-Ne-O_2 PLASMA. DeYoung, R.J.; Wells, W.E.; Miley, G.H. (Nuclear Engineering Program, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Appl. Phys. Lett. 28: No. 4, 194-197 (15 Feb 1976).

A single pass gain of ~ 0.9%/m (at 8446 Å in atomic oxygen) has been measured for a ^{3}He-Ne-O_2 plasma generated by the volumetric ^{3}He(n,p)^{3}H reaction induced by neutrons from a pulsed nuclear reactor. The plasma was contained in an optical cavity containing a chopping fan that permitted a measurement of the ratio of output 8446 Å from the normal cavity to that with the back mirror blocked. This ratio, called the unblocked-blocked ratio, was used to study the gain dependence on total pressure and concentration. The maximum gain observed was for a concentration of 0.048% O_2 and 1.5% Ne, at a total pressure of 600 Torr. The peak gain remained fairly constant with neutron fluxes from 10^{13} to 2.5×10^{13} n/cm² sec. Results of other concentration studies are also discussed. The laser medium is pumped by thermal neutrons from the Illinois TRIGA reactor that impinge on a 80-cm by 0.8-cm-i.d. glass tube containing from 50 to 800 Torr ^{3}He-Ne-O_2. (auth)

20086 CO_2 TEA LASERS SUSTAINED BY METASTABLE N_2. Olbertz, A.H.M.; Reits, B.J. (Physics Department, Twente University of Technology, Enschede, The Netherlands). Appl. Phys. Lett. 28: No. 4, 199-201 (15 Feb 1976).

Metastable N_2 is able to ionize the low-ionization seed gas tri-n-propylamine. In this way the entire CO_2 laser gas discharge can be sustained. (auth)

20087 NARROW-BAND PICOSECOND PULSES FROM AN ULTRASHORT-CAVITY DYE LASER. Fan, B.; Gustafson, T.K. (Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, California 94720). Appl. Phys. Lett. 28: No. 4, 202-204 (15 Feb 1976).

Narrow-band picosecond pulses have been generated by a 50-μ-long Rhodamine B laser pumped by the second-harmonic output of a passively mode-locked Nd : glass laser. (auth)

20088 ULTRAVIOLET LASER ACTION FROM Cu II IN THE 2500-Å REGION. McNeil, J.R.; Collins, G.J. (Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80523); Persson, K.B.; Franzen, D.L. Appl. Phys. Lett. 28: No. 4, 207-209 (15 Feb 1976).

We have obtained cw laser action from Cu II at 2486, 2506, 2591, and 2599 Å by exciting a neon discharge in a copper hollow cathode. We have observed 7-mW cw output power just above threshold and the output appears to saturate at 210 mW under quasi-cw operation. The four ultraviolet laser lines observed originate from the $3d^9 5s$ (^3D) term of Cu II. The quantum efficiency of the 2500-Å laser transitions approaches 25%. Each of the four Cu II laser transitions has been employed in the past by spectroscopists as a secondary wavelength standard in the ultraviolet. (auth)

20089 A POTENTIAL HIGH-EFFICIENCY Cl_2 ULTRAVIOLET LASER. Chen, C.H.; Payne, M.G. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Appl. Phys. Lett. 28: No. 4, 219-221 (15 Feb 1976).

An emission band extending from 2200 to 3000 Å has been observed following proton beam excitation of Ar-Cl_2 mixtures which is much more intense than the emission from Ar-N_2. The emission band was assigned to a bound-free transition in the chlorine molecule. The energy precursor of excited Cl_2 is the excimer Ar_2^* which emits a 1300-Å continuum. Ion-ion recombination can also contribute to this excited chlorine molecule. The emission continuum near the 1750 Å associated with ArCl* was also investigated. (auth)

20090 TIME BEHAVIOR OF SECOND-POSITIVE EMISSIONS FROM A FAST-DISCHARGE N_2+SF_6 LASER. Akins, R.P.; Lin, S. (University of California, San Diego, La Jolla, California 92093). Appl. Phys. Lett. 28: No. 4, 221-223 (15 Feb 1976).

The time behavior of spectrally resolved N_2 second-positive emissions recently observed in our fast-discharge N_2+SF_6 laser reveals some surprising features that cannot be explained on the basis of SF_6-catalyzed vibrational relaxation or collisional quenching of the lower-laser-level $B^3\Pi_g$. Instead, they suggest the existence of an extremely fast excitation process for the upper-laser-level $C^3\Pi_u$ involving SF_6 as an intermediary, although the kinetic path for such a process remains unclear. (auth)

20091 STRONG-SIGNAL LASER OPERATION. I. GENERAL THEORY. Hambenne, J.B.; Sargent, M. III (Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). Phys. Rev. A 13: No. 2, 784-796 (Feb 1976).

A Lamb semiclassical theory is developed for multimode, mode-locked laser operation. The equality of frequency spacings between adjacent modes causes population pulsations generated in the nonlinear atomic response to be integer multiples of the adjacent-mode spacing. This allows the atomic response to be written in terms of Fourier series, thereby reducing coupled differential equations of motion to algebraic equations ultimately expressible in terms of a continued fraction. A unidirectional ring configuration is assumed so that the more complicated spatial dependence of standing waves is avoided. Reductions are made to the rate-equation limit and to the special two-mode cases of bidirectional ring operation and single-mode, standing-wave, gas-laser operation. Numerical analysis of the equations is motivated. Specific results are given in the following (companion) paper. (auth)

20092 STRONG-SIGNAL LASER OPERATION. II. SPECIFIC CASES. Hambenne, J.B.; Sargent, M. III (Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). Phys. Rev. A 13: No. 2, 797-812 (Feb 1976).

The multimode strong-signal theory of the preceding paper is applied to a number of two- and three-mode cases. A two-mode stability analysis yields strong-signal counterparts to the third-order coupling parameter. Two-mode homogeneous-broadened operation leads to the discussion of population inversion gratings and associated Bragg

scattering. Symmetry properties of the equations for the bidirectional ring are examined. Results for Doppler-broadened two-mode special cases and the three-mode locked unidirectional-ring operation are presented. The strong-signal results are compared to those of the third-order and rate-equation-approximation theories. For the bidirectional ring the historical third-order domain of relative excitation from 1.0 to 1.2 is divided into a valid third-order region and a less accurate region. The condition of bistable operation vs monostable operation is seen to be dependent on the relative excitation and the amount of homogeneous broadening. Two types of bistable operation are seen to exist, one where one mode is completely suppressed and another where both modes may have nonzero intensities. (auth)

20093 NUCLEAR RADIATION ENHANCEMENT OF A HELIUM–MERCURY LASER. Akerman, M. A.; Konya, M.; Wells, W. E.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 133(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20094 Ne–N_2 LASER EXCITED ONLY BY NEUTRON REACTIONS. DeYoung, R. J.; Wells, W. E.; Verdeyen, J. T.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 134(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20095 INVESTIGATION OF THE EFFECTS OF REACTOR RADIATION SOURCES ON A GLOW DISCHARGE PLASMA. Walters, R. A. (Teledyne Brown Engineering, Huntsville, AL). Trans. Am. Nucl. Soc.; 22: 148-149(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20096 FISSION FRAGMENT EXCITATION OF ATMOSPHERIC-PRESSURE ARGON AND ARGON–NITROGEN MIXTURES. Davie, R. N. Jr.; Davis, J. F. III; Schneider, R. T. (Univ. of Florida, Gainesville). Trans. Am. Nucl. Soc.; 22: 149(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20097 POPULATION INVERSIONS IN HIGH PRESSURE LASERS. Skorupski, A. A.; Suckewer, S. (Inst. of Nuclear Research, Warsaw). Nukleonika; 20: No. 9, 807-821(1975).

Large population inversions in two-temperature hydrogen plasma were found for gas pressures up to a few atms. Inelastic atom-atom type collisions are taken into account. Major problems concerning population inversions and gas discharges in high pressure lasers are also discussed. (auth)

20098 POSSIBILITY OF USING AN AIRPLANE COMPRESSOR IN LASERS ON A CLOSED-CYCLE. Generalov, N. A.; Zimakov, V. P.; Kosynkin, V. D.; Raizer, Yu. P.; Roitenburg, D. I. (Inst. of Problem Mechanics, Moscow). Dokl. Akad. Nauk SSSR; 221: No. 2, 319-321(11 Mar 1975). (In Russian).

Results are presented on a study of the operation of an AI-20 airplane compressor which was tied into the closed cycle of a laser unit with gases having molecular weights varying from 4 to 29 at typical laser pressures. Under nominal conditions (air at 1 atm and n = 12,300 rev/min) this compressor gives a volume flow of 17 m^3/sec and a ratio of full pressure (static plus velocity thrust) at outlet and inlet R ≈ 8.5. The compressor was modified to prevent the inleakage of air, and to keep oil out of the gas. The compressor was operated on pure helium (M = 4), a laser mixture of $CO_2 : N_2 : He = 2 : 3 : 15$ (M = 11.6) and air (M = 29) at pressures of 20 to 40 torr. It was found that the volumetric flow rates for the light gases were somewhat higher than the flow rate for air. In addition, the flow rate increases linearly with an increase in compressor speed (rev/min). As for the dependence on pressure, it was found that for the laser mixture in the region of p = 30 to 40 torr the volumetric flow rate remains constant, and at p = 20 to 30 torr it decreases somewhat with decreasing pressure. The ratio of pressures R at the outlet and inlet decreases substantially with decreasing molecular weight of the gas. At a compressor speed of 12,300 rev/min in air at p = 30 torr the value of the ratio of pressures at outlet and inlet R is 3.2, and it is 1.7 to 1.9 in the light gases. Volumetric flows of 10 to 12 m^3/sec and a gas velocity of ~300 m/sec were obtained by the airplane compressor under typical laser conditions in a closed cycle. (SJR)

20099 PRESSURIZED LASER HOUSING. Hoag, E. D. (to Avco Everett Research Laboratory, Inc.). US Patent 3,921,098. 18 Nov 1975. Filed date 27 Sep 1974. 6p.

The working parts of a flowing gas laser are enclosed within a pressurized housing. An ionizer is mounted in proximity to the working region such that generated electrons pass into the working region wherein lasing action occurs. (auth)

20100 CROSSED-FIELD EXCITATION, PULSED GAS LASER. Caristi, R. F.; Leonard, D. A.; Itzkan, I. (to Avco Everett Research Laboratory, Inc.). US Patent 3,921,097. 18 Nov 1975. Filed date 30 May 1974. 8p.

A crossed-field excitation, pulsed gas laser is described having improved geometry such that operating high repetition rates are achievable in combination with high peak output power without the necessity of very high gas flow rates. Opposed generally U-shaped electrodes supplied with electrical pumping power in the conventional manner in combination with and separated by electrically insulating side wall members define an elongated lasing region generally rectangular in cross section and this geometry results in optimum cooling of the gaseous lasing medium and optimum electric field characteristics during operation thereby permitting increased pumping rates at increased output power levels as compared to typical transversely excited prior art devices. (auth)

20101 UNSTABLE SPLIT MODE LASER RESONATOR. Chenausky, P. P.; DeMaria, A. J.; Fradin, D. W.; Frieberg, R. J. (to United Technologies Corp.). US Patent 3,921,096. 18 Nov 1975. Filed date 16 Dec 1974. 6p.

An unstable laser resonator system which provides an output beam with enhanced power, energy distribution and optical characteristics is disclosed. Two separate regions of gain medium each of which has the maximum dimensions permitted by the physical constraints of superfluorescent and excited population decay characteristics resonate in a split mode optical cavity having a common interlocked region of resonance which incorporates the contributions of each gain medium and combines the composite intracavity mode prior to output coupling from the resonator. The resonator system produces a coherent, phase-locked, high power, symmetric output beam. Optical cavities based on both spherical and cylindrical optics are discussed. (auth)

20102 FREQUENCY STABILIZED LASER. Abrams, R. L.; Nussmeier, T. A. (to Hughes Aircraft Co.). US Patent 3,921,099. 18 Nov 1975. Filed date 16 Sep 1974. 8p.

Arrangements are disclosed for the frequency stabilization of a laser using an external gas cell providing an absorption resonance which is controllably tuned by means of the linear Stark effect. An error signal, which locks the laser to the desired oscillation frequency, is generated either by dither modulation of the Stark-effect cell voltage or by differential absorption in a pair of Stark-effect cells having their absorption resonances stagger tuned about the desired laser oscillation frequency. The disclosed arrangements are especially suited to stabilization of a waveguide CO_2 laser operating on the P(20) 10.6 mu laser transition. Advantages are the ability to stabilize the laser at any frequency within the laser tuning range and the elimination of undesired frequency modulation on the generated laser beam. (auth)

20103 GAS DYNAMIC LASER HAVING SHUTTER DOORS. Olinger, J. B. Jr.; Wahl, R. L. (to United Technologies Corp.). US Patent 3,921,100. 18 Nov 1975. Filed date 23 Sep 1974. 4p.

A gas dynamic laser is shown wherein gases containing constituents necessary to obtain a lasing action are passed through a nozzle array and directed into a lasing cavity and through a diffuser to an exit. An opening is located on each side of said lasing cavity with a shutter box outside of said cavity having a shutter door for opening or closing said opening. A mirror box is located behind each shutter box and contains a mirror. These mirrors are aligned with the openings in the lasing cavity with each door positioned between an opening and a mirror. Another outlet opening is positioned downstream of the first opening which provides an outlet opening for a laser beam. A shutter box is located around this opening and also houses a shutter door for opening and closing said opening. The mirror box which extends behind this shutter box includes opening means for permitting the output beam to pass through an aerodynamic window to atmosphere. Actuating means are provided for rapidly opening and closing said shutter doors. Bearing means including recirculating balls are located on the top and bottom of each shutter door to ride in tracks at an angle to the sealing surface on the laser device. Vacuum means are provided to reduce the pressure in the shutter box and mirror box independently of the pressure in the lasing cavity. (auth)

20104 PULSED INFRARED DIFFERENCE FREQUENCY GENERATION IN $CdGeAs_2$. Piltch, M. S.; Rink, J.; Tallman, C. (Los Alamos Scientific Lab., NM). Opt. Commun.; 15: No. 1, 112-114(Sep 1975).

Pulsed, discretely tunable infrared differences frequency generation using CO and CO_2 lasers was demonstrated in the chalcopyrite crystal $CdGeAs_2$. The process of a previously reported phase-matched mixing was employed. (auth)

20105 HIGH FREQUENCY AUTOMODULATION OF GIANT IMPULSE BY OPERATING Q-SWITCHING. Milinkevich, A. V.; Savva, V. A.; Samson, A. M.; Efendiev, T. Sh. Zh. Prikl. Spektrosk.; 21: No. 4, 604-612(Oct 1974). (In Russian)

The reason for the origin and the growth dynamics of automodulation with period T (time of passage of a photon through the resonator) were studied for giant impulses in a laser with operating Q-switching. It was shown that the basic principle of automodulation was the heterogeneous distribution of photon density through the resonator, which arises from rapid variations in losses and in the dependent retardation effect on emission in the active element. The dependence of the form of the modulated monoimpulse on the laser parameters was used to obtain a formula for the limiting extent of modulation under fixed laser characteristics. (Electr. Electron. Abstr.)

20106 DIRECT APPLICATION OF THE FAST FOURIER TRANSFORM TO OPEN RESONATOR CALCULATIONS. Johnson, M. M. (Univ. of Arkansas, Fayetteville). Appl. Opt.; 13: No. 10, 2326-2328(Oct 1974).

It is shown that the integral equations for resonators can be written in the form of convolution integrals. A graph is given of the ratio of the time required to compute resonator eigenmodes using the fast Fourier transform (FFT) to the time required to evaluate the resonator convolution equation directly as a function of the number of mirror grid points. Computational savings made by using the FFT are discussed. (Electr. Electron. Abstr.)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 19978, 19979, 20246, 20749, and 20787.

20107 (COM-75-10472-04) SUPERCONDUCTING DEVICES AND MATERIALS, A Literature Survey Issued Quarterly, October–December 1975. Issue No. 75-4. Olien, N. A. (comp.). (National Bureau of Standards, Boulder, Colo. (USA)). 1975. 128p. National Bureau of Standards, Boulder, CO.

Highlights of the literature on superconducting devices and materials are briefly reviewed. The review is followed by an extensive bibliography of approximately 2000 references (no abstracts). An author index is included. (TFD)

20108 (CONF-740936-) RESEARCH IN ELECTRIC TRANSMISSION AND DISTRIBUTION: THE UNIVERSITY'S ROLE. Proceedings of the Workshop held at the State University of New York at Buffalo, September 30 and October 1, 1974. (State Univ. of New York, Buffalo (USA)). 1974. 217p. State Univ. of New York, Buffalo.

From conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

Ten papers were presented at the conference. Seven papers were abstracted for ERA and two of these also appear in NSA. Three papers were previously processed for the energy data base. (RCK)

For abstracts of individual papers see: 20109 and 20110.

20109 (CONF-740936-, pp 51-58) RESEARCH ON VACUUM INSULATION FOR CRYOCABLES. Graneau, P. (Underground Power Corp., Cambridge, MA). 1974.

From conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In research in electric transmission and distribution: the university's role. (State Univ. of New York, Buffalo (USA)).

Vacuum insulation, as compared with solid insulation, simplifies the construction of both resistive or superconducting cryogenic cables. The common vacuum space in the cable can furnish thermal insulation between the environment and the cryogenic coolant, provide electrical insulation between conductors, and establish thermal isolation between go- and return-coolant streams. The differences between solid and vacuum high voltage insulation are discussed, and research on the design, materials selection, and testing of vacuum insulated cryogenic cables is described. (LCL)

20110 (CONF-740936-, pp 59-65) UNIVERSITY'S ROLE IN RESEARCH ON SUPERCONDUCTING POWER TRANSMISSION. Forsyth, E. B. (Brookhaven National Lab., Upton, NY). 1974.

From conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In research in electric transmission and distribution: the university's role. (State Univ. of New York, Buffalo (USA)).

Power transmission by superconducting cables appears to have enormous potential for the utility industry. It has still to be demonstrated that it will become a viable and economically competitive technology, however, development aimed at this goal by major research establishments has already exposed numerous research problems suitable for investigation by well qualified university departments without requiring large expenditures for equipment. What is missing in an organizational structure to relate work to the primary goals, monitor progress and influence the funding decisions of the major agencies. This does not seem difficult to set up, but continued success will require a long-term commitment from the participants. (auth)

20111 (LA-6171-PR) USERDA DIVISION OF ELECTRIC ENERGY SYSTEMS DC SUPERCONDUCTING POWER TRANSMISSION LINE PROJECT AT LASL. Progress Report No. 10, April 10-June 30, 1975. Keller, W. E.; Taylor, R. D. (comps.). (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1975. Contract W-7405-eng-36. 28p. Dep. NTIS $5.00.

The tenth progress report of the Los Alamos Scientific Laboratory dc Superconducting Power Transmission Line (SPTL) Development Project covers the period April 1 to June 30, 1975. A number of line configurations, including a high voltage dc SPTL design, are examined from a cryoengineering point of view. New calculations on the cryostabilization of the superconductors are presented. Measurements of the critical current on several new superconductors and on a 20-m, well-stabilized Nb_3Sn tape are reported. Acoustical emission is being evaluated as a new technique to predetermine damage to Nb_3Sn conductors during cable fabrication. (auth)

20112 PROBLEMS RELATED TO THE DEVELOPMENT OF CRYOCABLES. Deschamps, L.; Giraud, P.; Leroux, J. M.; Moisson, F. (Electricite de France, Paris). Elettrotecnica; 59: No. 5, 535-545(May 1972). (In Italian)

Resistive cryocables cooled with liquid nitrogen and superconducting cryocables cooled with liquid helium are advantageous for transmission of large amounts of energy due to improved thermal impedance and electrical conductivity. Various components of cryocables, future technical development and problems related to their implementation are reviewed. (auth)

20113 INVESTIGATIONS INTO SUITABILITY OF PLASTIC PIPES FOR CRYOGENIC TEMPERATURE CABLES. Frohn, H.; Stelzer, F. (Fachhochsch, Juelich, Ger.). Kunststoffe; 64: No. 4, 167-170(Apr 1974). (In German)

The suitability of PE and PTFE for insulating low temperature cables was examined. PE was found to be unsuitable because it does not stand the thermal stresses which occur during cooling. PTFE on the other hand is suitable. Its disadvantages are the fact that it cannot be welded and its high price. Furthermore, long pipes are not yet being produced in this material. (auth)

20114 POWER LOSSES IN A SUPERCONDUCTING CIRCUIT BREAKER MADE OF ALLOY WITH HIGH CRITICAL MAGNETIC FIELD INTENSITY. Reimers, A. V.; Fedotov, L. N.; Sokolova, G. N.; Mironova, L. S. Elektrichestvo; No. 10, 81-83(Oct 1971).

20115 TRANSPORT OF POWER BY REFRIGERATED CABLES AT VERY LOW TEMPERATURE, AND IN PARTICULAR BY SUPERCONDUCTING CABLES. Klaudy, P. Bull. Schweiz. Elektrotech. Ver.; 61: No. 25, 1179-1190(Dec 1970). (In French)

The use of superconducting cables for the transmission of large amounts of power is discussed, with particular relation to the progress made in recent years in the conception of refrigerating machines and in techniques of heat insulation. For large countries in course of development, which do not yet possess a power network, the transmission of direct current by superconducting cables would seem particularly interesting because of their high efficiency, especially for transmission of high and extra high voltages over large distances, such as on a continental scale, and permitting smoothing of daily consumption variations without loss. The development of superconducting cables for alternating current would also seem interesting for the supply of power to large urban centers. Results obtained at the low temperature institute at Graz regarding the development of superconducting cables are described.

20116 LOW TEMPERATURES AND THE PRODUCTION AND TRANSMISSION OF ELECTRICITY. Kurti, N. Met. Electr. (Madrid); 34: No. 393, 397-404(Jun 1970). (In Spanish)

The use of cryogenic techniques in the transmission and production of electrical energy, together with the operational costs and difficulties of such systems and their relative advantages is discussed. Superconducting systems are mentioned and applications of low-temperature transmission are given.

20117 MODEL FOR THE CURRENT ON A SUPERCONDUCTING TRANSMISSION LINE. Shadowitz, A. (Fairleigh Dickinson Univ., Teaneck, NJ). Physica; 49: No. 1, 141-152(1970).

A model is proposed for the flow of current on the superconducting wires connecting a battery and resistor. A longitudinal E component, present near the leading edge of a transient wave just outside the conductors, but not present in the steady-state

field, provides an impulse to the electrons, causing them to move thereafter with constant velocity. Since some electrons receive an impulse before other electrons, the negative surface-charge density is changed by the leading edge of a wave. When an impulse is opposite to the wave direction the surface becomes positive; when both are in the same direction the surface becomes negative. Equations are derived for surface-charge density, electron drift velocity, and the force between the two wires. It is found that the drift velocities on the two-wires are slightly different and that the force between wires can be attractive, zero, or repulsive.

20118 CRYOGENIC ELECTRICAL ENERGY TRANSMISSION. Klaudy, P. A. (Technische Hochschule, Graz). Elektrotech. Cas.; 21: No. 4-6, 370-395(1970).

Due to the progress achieved in the cooling machine and heat insulation technique, the construction of high power cables operating at very low temperatures seems quite possible. Consequently, in under-developed countries, where electrical power systems do not yet exist, dc superconducting cables will be of interest due to their high efficiency. The same holds true for very large territories in which medium and high voltage lossless dc superconducting cables will be of special importance as by their use the changing energy demand within these territories due to the time difference and for other reasons could easily be met. However, also in ac power systems superconducting cables working with the generator voltage can be applied profitably, when the power rating becomes too large for conventional HV lines. A report is given about work done in connection with the design of superconducting cables in Graz.

20119 PRODUCTION AND MAINTENANCE OF VACUUM IN SUPERCONDUCTING POWER CABLES. Fox, M. (British Insulated Callender's Cables Ltd., London). Vacuum; 20: No. 3, 97-107(Mar 1970).

The problems encountered in attempting to use vacuum to provide thermal and electrical insulation in superconducting power cables are discussed. It is shown that the outer sections of the cable, which are cooled only to liquid-nitrogen temperature, may readily be evacuated. The inner sections, which carry the electric power and are at liquid-helium temperature, would be much more difficult to evacuate, largely because lower operating pressures are required; great care would be necessary in construction and in testing for leaks. The types and numbers of pumps required are determined, and their cost estimated; this proves to be very small compared with the total cost of a cable.

20120 I–V CHARACTERISTIC OF A SMALL JOSEPHSON JUNCTION. Zil'berman, L.A. Sov. Phys.–Tech. Phys. 20: No. 4, 548-551 (Apr 1975).

A method is derived for calculating the I–V characteristic of a short Josephson junction. An exact equation for the time-averaged voltage across the junction and the direct component of the Josephson current are found in operator form. The I–V characteristics is calculated to fourth-order in the time constant of the junction. (auth)

20121 SUPERCONDUCTING MAGNETOMETER FOR HIGH RESOLUTION SUSCEPTIBILITY MEASUREMENTS. Cerdonio, M.; Cosmelli, C.; Romani, G.L. (Department of Physics, University of Rome and Gruppo Nazionale di Struttura della Materia, Rome, Italy); Messana, C.; Gramaccioni, C. Rev. Sci. Instrum. 47: No. 1, 1-5 (Jan 1976).

A susceptometer, based on various properties of superconductors, has been developed. It makes possible the resolution of differences in magnetic susceptibility of less than 1% of the diamagnetism of water, in the whole temperature interval between liquid helium temperature and room temperature, on sample volumes of about 0.1 cm^3. Two prototypes are presently in routine operation for measurements on solutions, suspensions, powders, and crystals. (auth)

20122 MECHANICAL SUPERCONDUCTING SWITCH FOR LOW TEMPERATURE INSTRUMENTATION. Siegwarth, J. D.; Sullivan, D. B. (Inst. for Basic Standards, Boulder, CO). Rev. Sci. Instrum.; 43: No. 1, 153-154(Jan 1972).

The switch is illustrated and described. The design utilizes a wiping (self-cleaning) contact which is common to most good room temperature switches. The contacts need carry only 1 to 10 mamp for application. This switch provides a large safety margin as it handles about 3 amp/contact without reverting to the normal state. The switch operation is very smooth at 4^0K but is a little sticky at room temperature. During the portion of the switching cycle that the contacts are closed, the switch remains superconducting even while the rotor is in motion. (auth)

20123 NONLATCHING JOSEPHSON JUNCTION LOGIC DEVICE. Schlig, E. E.; Zappe, H. H. IBM Tech. Disclosure Bull.; 17: No. 4, 1222-1223(Sep 1974).

20124 L-SHAPED JOSEPHSON TUNNEL DEVICE. Anacker, W.; Matisoo, J. IBM Tech. Disclosure Bull.; 17: No. 4, 1203(Sep 1974).

The base electrode is L-shaped so that the horizontal leg of the L is used for the tunnel junction area. Located over the base electrode is the oxide tunnel barrier. The counter electrode is deposited over the tunnel barrier, and a control line overlapping the entire Josephson structure is in the direction of the counter electrode. Because the base electrode is L-shaped, thick insulation need not be provided between it and control line. Since the counter electrode does not contain In, it is easy to provide a thick native oxide on it. Thus, the tunnel device is totally insulated from the control line. The gain curve for this configuration is the same as for the true "in-line" gate. (Electr. Electron. Abstr.)

20125 SUPERCONDUCTING "WEAK LINK" WITH BISTABLE-MEMORY PROPERTIES. Cuomo, J. J.; Harris, E. P.; Rutz, R. F. IBM Tech. Disclosure Bull.; 17: No. 4, 1238-1239(Sep 1974).

It has been found that bistable switches with memory properties such as those made of Si–AlN–W, when switched to an "on" or low-resistance state less than approximately 1000 ohms, become superconductors below a certain critical temperature. A preferred structure is shown where the contacts are Al and Nb to an AlN film 1 mu thick. (Electr. Electron. Abstr.)

20126 FORMING JOSEPHSON JUNCTIONS WITH IMPROVED STABILITY. Greiner, J. H. IBM Tech. Disclosure Bull.; 17: No. 4, 1207(Sep 1974).

Sputter etching with an inert gas or bombardment with ion, electron, laser or x-ray beams can be used to prepare the tunnel barrier surface for deposition of the counter electrode. The experimental conditions can be adjusted so that undesirable material is preferentially removed from the surface of the tunnel barrier. (Electr. Electron. Abstr.)

20127 AC LOSSES IN TWISTED MULTIFILAMENT COMPOSITE SUPERCONDUCTORS. Iwasa, Y.; Montgomery, D. B.; Silinsky, P. New York; Institute of Electrical and Electronics Engineers (1970). vp.

From 1970 digests of the international magnetics conference; Washington, DC, USA (21 Apr 1970).

The ac losses in a variety of twisted multifilament superconducting wires have been measured in the field sweep rates up to 10^6 Oe/s. Particularly, the ac losses as a function of pitch length or twist number per unit length have been investigated in these wires. The results show the importance of twisting for multifilament superconducting wires in reducing the ac losses. For an efficient performance, multifilament wire must be twisted until the pitch length is shorter than a critical length. The critical length has been found to depend on several parameters and these have been investigated in detail.

20128 ELECTRIC POWER TRANSMISSION BY CRYOCABLE. Schwab, A. M.; Deschamps, L. (Electricite France, Clamart). pp 168-171 of Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From fourth international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972).

Resistive cryocables which are cooled at liquid–nitrogen temperature (77°K) and superconducting cryocables cooled at liquid-helium temperature (4.2°K) seem to be well adapted to the transmission of very large amounts of energy. Their compactness, their thermal independence with the surrounding medium and the improved electrical conductivity permit higher currents and therefore, unit capacity can be increased. Conception of cryocables, knowledge of properties of their various components and cryogenic techniques have improved during the last few years. Economic study has been reviewed and the actual cost of this equipment could have been approached more accurately. Costs of transmission by ac resistive cryocables and by ac and dc superconducting cryocables are compared, and the advantage of these cryogenic techniques over the other new techniques is studied in relation to foreseeable future needs.

20129 ELECTRICITY TRANSMISSION AND CRYOGENIC CABLES. Went, J. J. (NV Kema, Arnhem, Netherlands). pp 35-40 of Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From fourth international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972).

A review is given of the problems of transmission of the electricity supply industry in Europe with special reference to the situation in the Netherlands.

20130 SUPERCONDUCTING LINK: FOR LABORATORY TESTS ON CONDUCTORS FOR SUPERCONDUCTING CABLES.

Rogers, E. C.; Cave, E. C.; Grigsby, R. (British Insulated Callenders and Cables Ltd., London). pp 127-133 of Low Temperatures and Electric Power. Oxford, Eng.; Pergamon Oxford, Eng. (1970).

From International Inst. on refrigeration; London, Eng. (24 Mar 1969).

The superconducting link was constructed as part of a study of the feasibility of ac superconducting power transmission systems, and was designed to meet the following requirements: to provide a test-bed for measurements of ac losses and thermal inleak on possible conductor systems of full-scale dimensions; to provide practical design and operating experience of a pilot-scale cryogenic system operating at liquid helium temperature; and to provide a laboratory demonstration of the current-carrying capability of an ac superconducting system. The link consists of a single-phase conductor system, in the form of a coaxial pair of niobium conductors of 3.5 and 5.5 cm diameter and 2.7 m length. The transformers were designed to permit currents of up to 5000A to be passed through the conductors under virtually short-circuit conditions. Both the transformers and the conductors are cooled to 4.2°K by ducts filled with liquid helium. The cryogenic system, conductors, transformers and cool-down procedure are described.

20131 PROBLEMS RELATED TO THE DEVELOPMENT OF CRYOCABLES. Deschamps, L.; Giraud, P.; Leroux, J. M.; Moisson, F. Malakoff, France; French Society Electricians (1971). vp. (In French).

Liquid nitrogen (77°K) cooled resistive cryocables, and liquid helium (4.2°K) cooled superconducting cryocables appear well adapted to the transmission of large amounts of energy owing partially to their thermal independence of the medium in which they operate, and partially to improved electrical conductivity making possible an increase in unit powers through an increase in currents. Following an analysis of the properties of the various components of these cryocables, the physical and technological development possibilities of each type are examined, as well as the problems related to their implementation.

20132 MODEL FOR A DIRECT CURRENT HYPERCONDUCTING CRYOCABLE. Aupoix, M.; Moisson, F.; Carbonell, E. pp 99-104 of Low Temperatures and Electric Power. Oxford; Pergamon (1970). (In French).

From International Inst. on refrigeration; London, Eng. (24 Mar 1969).

A model of a cryo-cable which was jointly realized by the research center of the Compagnie Generale d'Electricite, Cables de Lyon and the Center d'Etudes Cryogeniques de l'Air Liquide is described. This model, of 20 M in length, was tested for a nominal power of 80 Mw with a nominal current of 4000A. This high-purity aluminium cable was designed for a constant length operating at low temperature. The operating temperature was 20°K under a pressure of 20 bars of helium gas. The interior of the cable housing was superinsulated and it consisted of two cable lengths linked together with a compensating bellows against heat contraction. The temperature of the cable was maintained by a closed circuit system carrying cooled helium. With this short-length model, the major part of the available cooling capacity was used to cool the leads. The ends of the cable were so designed as to minimize the heat flux in their lower sections, thus reducing as far as possible refrigerating capacity requirements and to avoid disturbing thermal measurements. The arrangement of temperature points and voltage take-offs along the length of the model enables one to control the operation of the cable, current flow and refrigeration. This model represents an approach towards realizing an industrial cable.

20133 COMPOSITE CONDUCTORS FOR A SUPERCONDUCTING AC POWER TRANSMISSION CABLE. Taylor, M. T. (Central Electricity Research Labs., Leatherhead, Eng.). pp 119-125 of Low Temperatures and Electric Power. Oxford; Pergamon (1970).

From International Inst. on Refrigeration; London, Eng. (24 Mar 1969).

Electrical parameters are tabulated for a 750 mva 3-phase 50 hz S/C cable, cooled by liquid or supercritical helium at 4 to 6.5°K, for normal operation and fault conditions. The operation of the cable and its protection and structural characteristics are discussed. It is concluded that a conductor consisting of an aluminum tube (2 mm wall thickness) with a niobium coating would be acceptable for a S/C power cable. A conductor consisting of a thin niobium coating over a hard type II superconducting layer on a copper tube would be the most satisfactory.

20134 BASIC PROBLEMS OF DC POWER TRANSMISSION BY CRYOGENIC CABLES. Voigt, H. (AEG-Telefunken, Frankfurt am Main). pp 83-90 of Low Temperatures and Electric Power. Oxford; Pergamon (1970).

From International Inst. on Refrigeration; London, Eng. (24 Mar 1969).

A theoretical study is described to determine at what power level a single-conductor dc cryogenic cable will break even in cost with a conventional cable. Three cables are considered: copper at 343°K, aluminium cooled by liquid hydrogen at 23°K; a superconductor in supercritical helium at 5.5°K. Costs per kM are plotted for 440 and 880 kV against transmitted power, up to 6 and 12 GW respectively. Throughout the power range, the Al cable is more expensive than Cu, but the superconducting cable breaks even with Cu at 4.2 GW (440 kV) and 6.3 GW (880 kV) under the most favorable circumstances. Roughly similar results are obtained when annual costs are compared. Should worthwhile applications of superconducting cables be found, costs might break even at 2 to 3 GW.

20135 ELECTRICAL ENERGY TRANSMISSION VIA A DIRECT CURRENT SUPERCONDUCTOR CABLE. Delile, G. (Electricite de France, Clamart). pp 91-97 of Low Temperatures and Electric Power. Oxford; Pergamon (1970). (In French).

From International Inst. on Refrigeration; London, Eng. (24 Mar 1969).

On the basis of results obtained from the study of the cooling system for a superconducting connection, the author studied the general problem of the optimum design of a dc superconducting cable as a function of its rated power and allowing for the fault conditions to which it may be subjected. It is assumed that such a connection is used in the same way as the present dc links, i.e. to connect two points of the same ac system or two different ac systems. An optimum operating voltage is determined and the economic advantage of such installations is evaluated.

20136 COMPARISON OF SUPERCONDUCTING AND CRYO-RESISTIVE POWER CABLES. Rogers, F. C. (British Insulated Callenders and Cables Ltd., London). pp 135-144 of Low Temperatures and Electric Power. Oxford; Pergamon (1970).

From International Inst. on Refrigeration; London, Eng. (24 Mar 1969).

Comparisons are made of current ratings, refrigeration costs and overall cable costs. It is concluded that cooling with liquid nitrogen results in lower overall costs than cooling with liquid hydrogen, but that the cost of S/C cables is substantially lower than that of either type of cryo-resistive cable, over the whole power range considered. Relevant data are tabulated and cable designs are sketched.

20137 LOSSES IN SUPERCONDUCTING COAXIAL TRANSMISSION LINES. Voges, E.; Petermann, K. (Tech. Univ., Brunswick). Arch. Elek. Uebertrag.; 27: No. 9, vp(Sep 1973).

The conduction losses of superconducting coaxial transmission lines were calculated using the BCS surface impedance of a superconductor and are compared with classical solutions. Numerical results are given for niobium and lead for frequencies up to 200 GHz and temperatures between 4.2°K and the critical temperature T_c.

20138 REFRIGERATION REQUIREMENTS OF THE LN_2 CRYOCABLE. Graneau, P.; Parish, H. C.; Smith, J. L. Jr. (Massachusetts Inst. of Tech., Cambridge). J. Eng. Ind.; 93: No. 4, 1161-1165(Nov 1971).

20139 REFRIGERATION AND CIRCULATION OF HELIUM IN SUPERCONDUCTING POWER CABLES. Cairns, D. N. H.; Swift, D. A.; Edney, K. (Central Electricity Research Labs., Leatherhead, Eng.). pp 155-162 of Low Temperatures and Electric Power. Oxford; Pergamon (1970).

From international inst. on refrigeration conference, London, Eng. (24 Mar 1969).

A study is made of the requirements for the refrigerators which would need to be spaced along the route of an AC superconducting power cable. Possible refrigerator and load combinations are compared, and it is concluded that it should be possible to design helium refrigerators to match the likely operating conditions of s/c cables. The best method of circulating the coolant through the cable will be a low-temperature multistage centrifugal pump, which is not yet available. Cable cooldown may be troublesome, and could take 2 to 3 weeks.

20140 DIELECTRIC DESIGN CRITERIA FOR SOLID-INSULATED SUPERCONDUCTING AC CABLES. Swift, D. A. (Central Electricity Research Lab., Surrey, Eng.). Proc. Inst. Electr. Eng. (London); 118: No. 9, 1237-1241(Sep 1971).

The electrical and the thermal requirements of a solid dielectric for superconducting ac cables were determined theoretically. From some recently published data on thin samples, such criteria seem attainable with certain nonpolar polymers, i.e., the range for experimental work on more relevant dimensions and geometry

is specified. The transmission characteristics of such a cable are considered good. Economic and technical comparisons are made with similar cables which have nonsolid insulants.

20141 UNCONVENTIONAL METHODS OF POWER TRANSMISSION USING DEEP FREEZING. Astakhov, Y.U.N.; Venikov, V. A.; Zuev, E. N.; Okolotin, V. S. Elektrichestvo; No. 5, 1-9 (May 1971). (In Russian)

The state of the art and projects under way in the Soviet Union and abroad, mostly concerning superconducting cables are reviewed.

20142 AC LOSSES IN TUBULAR SUPERCONDUCTING COMPOSITES WITH ANISOTROPIC SURFACE STRUCTURE. Carter, C.N.; Male, J. C.; Graeme-Barber, C. (Central Electricity Research Lab., Surrey, Eng.). Cryogenics; 14: No. 6, 332-339(Jun 1974).

The conductors were of 15 and 19 mmm diameter, with a niobium surface layer bonded to a copper substrate either directly or via an intermediate layer of niobium-titanium alloy. For purely topological anisotropy, manifest in practice as longitudinal corrugations, circumferential currents gave the lower losses. For largely compositional anisotropy, such as longitudinal welds or strips of degraded surface material, circumferential currents gave the greater losses. These results have been interpreted in terms of the surface current distribution in each case. 6 refs.

20143 LIGHTNING IMPULSE AND SWITCHING SURGE BREAKDOWN OF LIQUID NITROGEN-IMPREGNATED WRAPPED DIELECTRICS FOR CRYOGENIC CABLES. Belanger, B. C. (General Electric Co., Schenectady, NY). IEEE Trans. Power Appar. Syst.; PAS-90: No. 6, 2616-2621(1971).

Experimental results are presented which indicate that flexible resistive cryogenic EHV cables employing a liquid nitrogen-impregnated dielectric wrap will withstand values of electric stress under lightning impulse and switching surge conditions comparable to those achievable in oil/paper cables.

20144 GEOMETRIC ARRANGEMENTS FOR MAXIMIZING POWER-TRANSMISSION CAPABILITY IN SUPERCONDUCTING TRANSMISSION CABLES. Guthrie, G. L. (Wadco Corp., Richland, WA). J. Appl. Phys.; 42: No. 13, 5719-5726(Dec 1971).

An analysis is given of the power carrying capability of several geometric arrangements of superconducting transmission cables for use in dc, single- phase ac, and three- phase ac applications. The discussion includes calculations of maximum energy densities for several three- phase ac geometric arrangements. A theoretical upper limit is given for the energy/cm^2 which may be sent down a superconducting cable of a given type- I material and dielectric, independent of the geometry adopted.

20145 POWER TRANSMISSION OVER THE VERY-LOW TEMPERATURE CABLES, ESPECIALLY BY SUPERCONDUCTING CABLES. Klaudy, P. Bull. Schweiz. Elektrotech. Ver.; 61: No. 25, 1179-1190(12 Dec 1970). (In French).

The results of the investigations conducted at the Very Low Temperature Institute, Graz, Austria are reviewed.

20146 DEVELOPMENT OF A SUPERCONDUCTING CABLE FOR TRANSMISSION OF HIGH ELECTRIC POWER. Moisson, F.; Leroux, J. M. (Compagnie Generale D'Electricite, Marcoussis, France). J. Appl. Phys.; 42: No. 1, 154(Jan 1971).

The opportunities opened by the use of cryoresistive and superconducting materials in underground transmission systems have led to a cryocable program. A first set of problems associated with the development of cryogenic cables deals with the cable system, i.e., design, safety, terminal equipment including leads, cryogenic equipment, refrigerators, and problems related to overload capability and reliability. A second set concerns the cable itself, i.e., scientific and technological problems associated with the conductor, the electrical insulation, and the thermal exchange between conductor and helium. Useful experience is gained on the design problems and on the technological problems involved in the construction of a cryoconducting cable. A 20-M aluminum cable cooled down to 25^{0}K with pressurized helium flow was built and tested with 3500-A dc under 20 Kv; results are presented. On this model the following types of problems were solved. First, mechanical problems concerning cooling of the cable, thermal contraction of the pipes, electrical insulation and conductors, construction of an invariable cable constituted by elementary helically wound conductors were solved. Second, thermal problems of reduction of heat leaks, conception of thermal insulation, and segmentation of vacuum jackets were solved. Third, electrical problems of design of 300^0 to 25^{0}K leads were solved; this problem of losses at both ends is, in proportion, more important for the short model than for long cable. Finally, refrigeration problems of helium and nitrogen flows, thermal shields and design of refrigerators (optimal capacity and spacing) were solved.

20147 NEGATIVE SELF-INDUCTANCE IN SUPERCONDUCTING THIN WIRES AND WEAK LINKS. Christiansen, P. V.; Hansen, E. B.; Sjostrom, C. J. (Univ. of Copenhagen). J. Low Temp. Phys.; 4: No. 4, 349-389(Apr 1971).

The concept of negative self-inductance is explained by deriving the velocity dependence of the superinductance on the basis of the uniform Ginsburg-Landau (GL) solution. A formulation of the GL theory is presented which is suited for describing the depairing effects in a thin wire or film. The stability of the solutions to the GL equations is discussed. It is found that for a long wire or film negative self-inductance and instability always go together. An application of the developed theory to weak links is considered.

20148 I-V CHARACTERISTICS OF JOSEPHSON CONTACTS. Landa, P. S.; Tarankova, N. D. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 20: No. 2, 82-87(Feb 1975).

Translated from Radiotekh. Elektron.; 20: No. 2, 353-359 (Feb 1975).

The behavior of the induced "steps" on the I-V characteristics of Josephson contacts is investigated for the case of a harmonic microwave signal and a signal in the form of rectangular pulses. The effect of wide-band fluctuations on the shape of the steps is also examined. (auth)

20149 RADIATION OF ELECTROMAGNETIC ENERGY BY A SYSTEM OF JOSEPHSON CONTACTS THROUGH A SEMI-TRANSMITTING SCREEN. Pavlyuk, V. A.; Bystrov, V. A.; Butorin, V. M.; Dmitriev, V. M. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 20: No. 2, 158-160(Feb 1975).

Translated from Radiotekh. Elektron.; 20: No. 2, 445-447 (Feb 1975).

The radiation of electromagnetic energy by a system of tunnel contacts through a partially transmitting screen is examined. An analysis of the solution obtained makes it possible to determine the condition for total transmission of the microwave power, generated by the Josephson current, into free space. (auth)

20150 SUPERCONDUCTING POWER CABLES. Maddock, B. J. (Central Electric Research Labs., Leatherhead, Eng.). Phys. Technol.; 6: No. 6, 266-272(Nov 1975).

The potential merits of superconducting cables such as compactness, high power capacity per cable, some reduction of running losses, and lower capital costs are discussed. These benefits will not become substantial until cables with ratings of several thousand MVA are required—two or three times present needs. Many arrangements are possible and there is plenty of scope for ingenuity and innovation in the design. The cable arrangement, choice of conductor, electrical insulation, thermal insulation and refrigeration, and the economics of superconducting power cable systems are discussed. (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 22315 and 22596.

20151 (ANL-CT-76-22) MATHEMATICAL AND PROGRAMMING DETAILS OF THE TEACH T AND L RECIRCULATING FLOW CODE. Salimomu, D. O. (Argonne National Lab., Ill. (USA)). Oct 1975. 45p. AT.

A summary of the essential mathematical details of both TEACH programs is presented. The variables used in the programs and the functions of each of the program subroutines are explained. (auth)

20152 (BARC-791) DEVELOPMENT OF AN OIL FREE VACUUM DEPOSITION UNIT. Patel, R. J.; Dewan, S. G.; Gopalaraman, C. P. (Bhabha Atomic Research Centre, Bombay (India). Technical Physics Div.). 1975. 19p. Dep. NTIS (US Sales Only) $3.50.

An oil free vacuum deposition unit using combination pumping of cryosorption pumps and an orbitron pump for thin film depositions at low pressures has been developed. Pressures in the ranges of 10^{-7} and 10^{-8} torr in a 50 l volume are routinely realized within about an hour without involving time consuming bakeout procedures. General features and the technique in producing such low pressures in unbaked conditions of the plant are discussed. A few trial runs are made to vacuum deposit carbon and aluminium thin films onto a glass substrate. Residual gas analysis of the plant under unbaked operating condition is made. At a total pressure of 2×10^{-7} torr, water vapor is the dominant gas load and constitutes over 72% of the total residual atmosphere. The active long chain hydrocarbons and oxygen are not present in the spectrum. (auth)

20153 (CNLM-6351) LITERATURE SEARCH OF HIGH VELOCITY CROSS FLOW FLUID. Tayntor, P.; Blecherman, S. S. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 29 Jul 1965. 7p. Dep. NTIS $3.50.

The following literature search was performed to investigate the effects of high velocity cross flow fluid through a bundle of tubes on the engineering parameters used to describe fluid flow and heat transfer. In particular, it was of interest to determine the local behavior of the heat transfer coefficient (h) since this term describes the film boundary behavior at the liquid to solid interface. It has been experimentally shown for liquid metals as well as other heat transfer fluids, that film boundary conditions do affect the rate of mass transfer. The precise relationship between material removal and the boundary conditions are presently unknown for the refractory metal alkali metal systems of interest. The average heat transfer coefficient is usually all that is of engineering interest since local deviations are both difficult to predict and usually have very little influence on the overall coefficient in large engineering systems. This review attempts to provide a qualitative insight to the variation of the film boundary for liquid metals at various flow rates both circumferentially around a tube, and at various positions within the tube bundle. This information could be of considerable assistance in both the design of a heat exchanger system, as well as in the evaluation of materials effects occurring at various points in a multitube system. (auth)

20154 (IEA-378) VOID-FRACTION MEASUREMENT IN A TWO-PHASE AIR–WATER FLOW IN A VERTICAL TUBE. de Mello, R. E. F.; Behar, M. R.; Martines, E. W. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1975. 29p. (In Portuguese). Dep. NTIS (US Sales Only) $4.00.

The utilization of the radioactive tracer technique to measure the void fraction in a two phase air–water flow is described. The radioactive tracer used was a salt of ^{82}Br. The water flow rate was varied between 0.4 and 2.0 m^3/h, the air flow rate between 0.2 and 1.0 m^3/h. The resulting measured void fraction were between 0.05 and 0.32. These measured void fraction values were compared with those calculated with the measured flow rates and by use of empirical formulas obtained by other authors, using different methods. After a convenient choice of the radioactive isotope, the measurements presented no special problems. The results are in good accord with the values calculated by the formulas of R. Roumy, but no conclusions were made about the convenience of application and the confidence level of this method. (auth)

20155 (KFK-2208) BUBBLE FORMATION AND HEAT TRANSFER DURING DISPERSION OF SUPEPHEATED VAPOR IN SATURATED WATER. Schmidt, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorbauelemente). Sep 1975. 88p. (In German). Dep. NTIS (US Sales Only) $5.00.

Thesis. Submitted to Karlsruhe Univ., Ger.

An experimental investigation of bubble formation and detachment with simultaneous heat transfer from single submerged orifices at high system pressures and temperatures is described. The experiments were made in a water vapor–water system. The superheated vapor is injected out of a 5 cm^3 ante-chamber through nozzles with dia of 1.5; 2 and 3 mm into demineralized saturated water. The vapor flow rate is varied in the range of 2 to 20 g/min. The system pressure varied to 212 atm. The vapor temperatures examined were 100, 150, 200°K. The experimental observations were interpreted by means of dimensional analysis. The following results were obtained: relations between the bubble shape, the formation frequency, and the physical parameters of the system are pointed out; the relevant effect on transition from stationary bubble formation (single bubble formation) to instationary bubble formation (coagulation of the bubbles during detachment) is found to be an oscillation characteristic of the bubble; and, during bubble formation a decrease of 40 to 60% of the temperature of superheating is observed. The values of the average heat transfer coefficient are in the range of 0.05 to 0.75 W/cm^2K. The heat transfer is given as a function Stanton number vs. Reynolds number. (auth)

20156 FLOW OF INTERPENETRATING MATERIAL PHASES. Harlow, F. H.; Amsden, A. A. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 18: No. 4, 440-464(Aug 1975).

A previously described numerical technique for the solution of multiphase flow dynamics problems is here both simplified and extended. The simplification cuts down slightly on the momentum coupling among fields, allowing for considerable reduction in complexity of the formulation. The extensions include the capability for compressibility in each material phase, the addition of more interpenetrating fields, and the allowance for motion of a liquid or vapor through a close-packed field of particles. The technique is illustrated by computer-generated plots from a time-varying three-field calculation in a cylindrically symmetric configuration. (auth)

20157 MEASUREMENT OF MODULATION TRANSFER FUNCTIONS OF NEUTRON RADIOGRAPHIC SYSTEMS. Alger, D. M.; Bull, S. R. (Univ. of Missouri, Columbia). Trans. Am. Nucl. Soc.; 22: 145-146(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20158 LAMINAR HEAT TRANSFER DATA WITH A STEP-VARYING WALL HEAT FLUX. Reisman, O. I. (Newark Coll. of Engineering, NJ); Parker, R. O. Trans. Am. Nucl. Soc.; 22: 572(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20159 DEVELOPMENT OF AN OPTICAL METHOD FOR MEASUREMENT OF TEMPERATURE FLUCTUATIONS IN TURBULENT FLOWS. Bennett, R. G.; Golay, M. W. (Massachusetts Inst. of Tech., Cambridge). Trans. Am. Nucl. Soc.; 22: 581(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20160 NON-STEADY-STATE, BOILING BURNOUT AT VARIOUS INITIAL HEAT FLUXES AND HEAT CAPACITIES OF THE HEATER. Tolubinskii, V. I.; Ostrovskii, Yu. N.; Pisarev, V. E. (Inst. of Tech. and Thermophysics, Kiev). Teplofiz. Teplotekh.; No. 29, 3-5(1975). (In Russian).

Experimental data are presented with regard to the combined effect of initial heat flux level and thickness of heater on the non-steady-state thermal burnout heat fluxes q_{bn} for acetone and ethyl alcohol. It was found that the burnout heat flux depends on the hydrodynamic conditions in the laminar layer near the wall, which are determined by the initial heat flux q_{init}. For all heaters the effect of initial heat flux q_{init} ends in the region of the start of boiling. With increasing thickness of the heating element the relative difference decreases between the non-steady-state burnout flux q_{bn} and the burnout flux q_b, which is obtained by a smooth increase in thermal flux. (SJR)

20161 HEAT TRANSFER IN BUBBLE COLUMNS. Mersmann, A. (Technical Univ., Munich). Chem.-Ing.-Tech.; 47: No. 21, 869-872(Nov 1975). (In German)

Dimensioning of heating or cooling surfaces in bubble columns requires a knowledge of the heat transfer coefficient between the dispersed two-phase layer and the heat-transferring wall. Such heat transfer coefficients have already been frequently determined experimentally so that it is now possible to compare the values obtained by various authors. An equation for calculating this coefficient is proposed which formally corresponds to the relation for heat transfer on free convection. The Grashof number characterizing the free convection process is replaced by the Archimedes number, which characterizes the fluid dynamics in bubble columns. Graphic representation of experimental values obtained by various authors shows that the proposed relations apply for gas loadings of more than 0.03 m^3/m^2s. (auth)

20162 EXPERIMENTAL INVESTIGATION OF DRY PATCH FORMATION AND STABILITY IN THIN LIQUID FILMS. McAdam, D. W. T. Vancouver, British Columbia; Univ. of British Columbia (1975). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

An experimental study was conducted on the formation and stability of dry patches in a thin liquid film flowing down a heated plate. The occurrence of such a dry patch is of great practical significance since, in some cases, the loss of liquid cooling effect allows the temperature of the heated surface to exceed its melting point. This is particularly dangerous in a high heat flux, two-phase system such as the core of a boiling-water-cooled reactor. Previous theoretical analyses indicate that dry patch stability and possible rewetting depends on a balance between inertia forces at the upstream edge tending to rewet the dry patch and surface tension and thermocapillary forces which cause it to spread. Dynamic contact angle is particularly significant in these analyses. Direct experimental confirmation of these analyses was not previously possible because measurements of dynamic contact angle under film break up conditions have never before been made. The present experiments indicate that one criterion for a stable dry patch is a balance of body forces by surface tension forces and this is characterized by the Bond number. This is approximately equal to one, based on measured film thickness. Measured results compare well with theoretical analyses in laminar films at Reynolds numbers less than 250. At higher Reynolds numbers theoretical results do not agree with measured results. Further models are required which consider the three-dimensional nature of the stagnation point, the dynamic effect of surface waves on contact angle and which give good predictions of minimum thickness in turbulent films. (Diss. Abstr. Int., B)

Materials Testing

Refer also to abstracts 20256, 22059, 22060, 22564, 22566, 22568, and 22569.

20163 (AGARD-AG-201(Vol.1)) NONDESTRUCTIVE INSPECTION PRACTICES. Volume I. Bolis, E. (ed.). (Advisory Group for Aerospace Research and Development, 92- Neuilly-sur-Seine (France)). Oct 1975. 478p. NTIS.

The NATO Advisory Group for Aerospace Research and Development has prepared this publication for the purpose of presenting a reference manual on nondestructive inspection (NDI). Although the material is oriented towards NDI of aircraft components, the publication should be useful to those interested in almost any field of NDI. Separate abstracts have been prepared for three chapters for inclusion in NSA. The remaining thirteen chapters are not in scope for NSA. (TFD)

For abstracts of individual chapters see: 20164–20166.

20164 (AGARD-AG-201(Vol.1), pp 93-128) CRITICAL SURVEY OF METHODS. van der Schee, E. J.; Bijlmer, P. F. A. (Fokker VFW B. V., Amsterdam). Oct 1975.

In nondestructive inspection practices. Vol. I.

Visual, acoustical, and ultrasonic methods of nondestructive testing are briefly examined. (TFD)

20165 (AGARD-AG-201(Vol.1), pp 232-267) X-RADIOGRAPHY. de Sterke, A. (Roentgen Technische Dienst B. V., Rotterdam). Oct 1975.

In nondestructive inspection practices. Vol. I.

After a brief historical review of x-ray radiography the following topics are discussed in some detail: principles of radiography; x-ray equipment; processing of films; and practical application of x-radiography to aircraft structures and problems involved. An annex presents radiation safety aspects of x-ray radiography. Topics discussed include characteristics of radiation sources; radiological units; maximum permissible doses; personnel dosemeters; monitoring; and shielding and protection. (TFD)

20166 (AGARD-AG-201(Vol.1), pp 295-329) GAMMAGRAPHY IN AIRLINE MAINTENANCE. Van Averbeke, M. (SABENA, Zaventem, Belg.). Oct 1975.

In nondestructive inspection practices. Vol. I.

Definitions and brief explanations for several terms and concepts pertaining to gamma radiography are given. Gamma radiography of several aircraft components is briefly discussed. (TFD)

20167 (HEDL-TME-75-133) FEASIBILITY STUDY ON INFRARED ELECTRO-THERMAL NDE OF STAINLESS STEEL. Green, D. R.; Hassberger, J. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 20p. Dep. NTIS $4.50.

Electro-thermal examination, a branch of thermal testing (TT), is a promising method being developed for NDE of stainless steel welds. This report describes the first phase of development; i.e., preliminary demonstration and laboratory evaluation of the method's sensitivity to notches in Type 304 stainless steel plate specimens. It also includes a description of the basic principles, together with a description of the hardware and experimental results showing that electrical discharge machined notches down to 0.16 cm (0.06 in.) long x 0.08 cm (0.03 in.) deep were detected. A qualitative technique for interpreting the test results to determine whether defects are at the surface or deeper within the material is demonstrated. (auth)

20168 (HEDL-TME-75-134) DEVELOPMENT OF ULTRASONIC METHODS FOR EXAMINING STAINLESS STEEL WELDS. Interim Progress Report. Peterson, R. O.; Spanner, J. C.; Mech, S. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 31p. Dep. NTIS $5.00.

Spurious ultrasonic (UT) signals obtained during the examination of austenitic stainless steel welds in LMFBR components have emphasized the need to develop more effective UT methods to supplement the examination processes presently employed during fabrication, and for use during subsequent in-service inspection of LMFBR plants. This interim report documents the first year's effort on a program that was designed to investigate this problem and develop viable solutions. Sixty-eight weld samples were acquired, cataloged, and subjected to a series of ultrasonic, radiographic, and metallographic examination procedures. It was determined that although spurious UT noise signals could usually be associated with major dendritic grain growth patterns, the existence and magnitude of some of the observed noise signals could not be explained simply on the basis of dendritic microstructure. The results obtained during application of a series of ultrasonic and radiographic characterization procedures are included, in addition to photomicrographs and photomicrographic montages taken in the vicinity of numerous sites which produced ultrasonic noise signals of various amplitudes. A concurrent investigation was conducted to evaluate the performance of conventional ultrasonic examination procedures. These results are compared with the laboratory investigation results, and a brief outline of future work planned under this program is presented. (auth)

20169 (JAB-99-119) VIBRATION TESTS OF A 4-STORY REINFORCED CONCRETE TEST STRUCTURE. Chen, C. K.; Czarnecki, R. M.; Scholl, R. E. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Jan 1976. 108p. Dep. NTIS $6.50.

The results of a series of vibration tests conducted in 1974 to determine the dynamic response characteristics of a 4-story concrete test structure located at the Nevada Test Site are presented. The testing of this structure can be generally categorized as follows: nondestructive tests consisting of frequency sweep tests and frequency dwell tests, exciting four translational modes of vibration in the north-south (longitudinal) direction and three modes in the east-west (transverse) direction at low and intermediate force levels; a destructive test consisting of a frequency dwell test, exciting the lowest north-south translational mode at intermediate and high force levels, during which the structure exhibited inelastic response and suffered major structural damage; and a series of post-destructive tests using force levels similar to the nondestructive tests, conducted to investigate the response of the structure after it had experienced structural damage. The damping values of all modes over the range of nondestructive testing varied from 1.3 percent to 2.3 percent of critical. The damping in the second mode appeared to be higher than in the other modes at all amplitudes within the measurements, suggesting a complex but as yet undefined relationship between frequency, mode shape, amplitude, and damping in such structures. Mode shape of vibration for each mode measured in one direction of motion was found to be nearly constant regardless of levels of excitation. No observable damage was found during this test series. (auth)

20170 NEUTRON RADIOGRAPHY OF A GRID-TYPE SUBASSEMBLY. Taylor, D. S.; Harrison, L. J.; White, J. R. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 751(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Nuclear Explosions

Refer also to abstracts 20201, 20244, and 22675.

20171 (SAND-75-0486) COMPARISON OF PREDICTED AND OBSERVED PORE PRESSURE INCREASES ON RIO BLANCO. Banister, J. R.; Eliett, D. M.; Pyke, R.; Winters, L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 84p. Dep. NTIS $6.00.

The RIO BLANCO event presented the opportunity to monitor, under controlled conditions in the field, the increase in pore pressures resulting from ground motion similar to an earthquake. In situ measurements of pore pressure changes were made by Sandia Laboratories and Dames and Moore. This report contains the results of laboratory tests believed to be indicative in assessing the magnitude of pore pressure increases and probability of soil liquefaction. These include triaxial load tests, gradation of grain size, and relative density. No liquefaction was observed in the field, and the increase of in situ pore pressures were much less than expected from laboratory measurements. Allied subjects presented in this report are pore pressure propagation and dissipation profiles, the previously unpublished pore pressure measurements made by Dames and Moore, and the boring logs for the various sites where measurements were taken. It is concluded that methods used to predict pore pressure increases and liquefaction potential are overly conservative, at least for these alluvial and colluvial soils found in Colorado. (auth)

20172 (UCID-17018) FLOW THROUGH POROUS MEDIA FROM A NUCLEAR CAVITY. Morrison, F. A. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-Eng-48. 29p. Dep. NTIS $4.00.

The transport of fluid from the cavity formed by an underground nuclear explosion was investigated. Driven by the high cavity pressure, steam and noncondensing gas enter the surrounding porous medium. Their subsequent motion through the medium is described and the extent of penetration determined. The relations governing the transport are presented. An implicit iterative computational method is developed. The relative merits of this tech-

nique are discussed. The method is applied to a nuclear test. Results of calculations are presented and discussed. (auth)

20173 (UCRL-51975) MEDIUM PROPERTIES AND TOTAL ENERGY COUPLING IN UNDERGROUND EXPLOSIONS. Kurtz, S. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1975. Contract W-7405-Eng-48. 46p. Dep. NTIS $4.00.

A phenomenological model is presented that allows the direct calculation of the effects of variations in medium properties on the total energy coupling between the medium and an underground explosion. The model presented is based upon the assumption that the shock wave generated in the medium can be described as a spherical blast wave at early times. The total energy coupled to the medium is then simply the sum of the kinetic and internal energies of this blast wave. Results obtained by use of this model indicate that the energy coupling is more strongly affected by the medium's porosity than by its water content. These results agree well with those obtained by summing the energy deposited by the blast wave as a function of range. (auth)

20174 (UCRL-51981) TACTICAL NUCLEAR STUDIES: A MORE COMPREHENSIVE APPROACH. Blumenthal, D.; Kooshian, C.; Reinhardt, G.; Staehle, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $3.50.

A matrix scheme for evaluating complex tactical nuclear systems is proposed. Advantages resulting from consideration of system characteristics in peace and crisis as well as war include avoidance of scenario-dependent conclusions, ease of maintaining awareness of relationships between immediate concerns and the complex whole, and highlighting of areas or concerns that have been overlooked or neglected. (auth)

20175 COMPARATIVE STUDY OF STRUCTURAL RESPONSE TO EXPLOSION-INDUCED GROUND MOTIONS. New York; American Society of Civil Engineers (1975). 144p. (PNE-RB-74). $6.00.

Results of ground motion effects on mechanical structures in the vicinity of the Rio Blanco Event are presented. The structures observed included a 100 ft high truss-type microwave tower, a 70 ft vertical, cylindrical steel, refinery-type structure, a single-story wood frame residence, an 80 ft clear span, wood roof, reinforced-concrete column gymnasium, and an 80 ft high earth-fill dam. The investigation was done in the hope that the results obtained will provide further impetus for the incorporation of dynamic earthquake analysis requirements in building codes. (TFD)

20176 ANALYSIS OF SEISMIC RESPONSE IN THE CITY OF LAS VEGAS, NEVADA: A PRELIMINARY MICROZONATION. Murphy, J. R.; Hewlett, R. A. Bull. Seismol. Soc. Am.; 65: No. 6, 1575-1597(Dec 1975).

Ground motion data recorded at 26 different locations in Las Vegas from six underground nuclear tests have been used to perform a preliminary microzonation of the city. The microzonation results are presented in the form of contour maps of the average observed seismic response throughout the city in 12 different frequency bands covering the period range from 0.16 to 6.0 sec. These data indicate that variations in long-period seismic response of as much as an order of magnitude can be expected at sites only a few kilometers apart in the city. Simple models of surface-wave propagation in the surface layer of alluvium of variable thickness can account for much of the observed variability. However, it appears that surface waves reflected back from the valley boundaries at the base of the surrounding mountain ranges also have a significant effect on the measured response. (auth)

20177 METHOD AND APPARATUS FOR GENERATING STEAM BY NUCLEAR EXPLOSION WITH SUPPRESSED RADIATION AND BLAST EFFECTS. Rosciszewski, J. J. US Patent 3,921,405. 25 Nov 1975. Filed Date 19 Dec 1973. 6p.

The generating of steam by exploding a thermonuclear bomb in an expansion chamber in a breakable container filled with working fluid or solid that is placed in the expansion chamber that is then evacuated, and after initiating the thermonuclear explosion, utilizing the energy released to directly evaporate the enclosing working fluid or solid and expanding it in the much larger chamber volume to pressure and temperatures suitable for a power generation. (auth)

Safety Engineering

20178 (NCSR-R-2) SYSTEMS RELIABILITY IN HIGH RISK SITUATIONS. Hunns, D. M. (National Centre of Systems Reliability, Culcheth (UK)). 1974. 10p. Dep. NTIS (US Sales Only) $3.50.

A summary is given of five papers and the discussion of a seminar promoted by the newly-formed National Center of Systems Reliability. The topics covered include hazard analysis, reliability assessment, and risk assessment in both nuclear and non-nuclear industries. (UK)

Vacuum Engineering

20179 VAKUUMNYE SISTEMY ELEKTRO-FIZICHESKIKH USTANOVOK. (Vacuum Systems for Electrophysical Installations). Glazkov, A. A.; Malyshev, I. F.; Saksaganskii, G. L. Moscow; Atomizdat (1975). 192p.

The basic principles of the physics, techniques, technology, and design of vacuum systems for electrophysical installations are presented. Vacuum requirements are formulated for charged particle accelerators and thermonuclear installations, and examples of vacuum systems constructed in recent years are given. A description is given of the construction of vacuum chambers, accessories, and special equipment, and the basic properties of vacuum materials are considered. 20 tables, 54 figures, 191 references. (SJR)

20180 EFFICIENT ULTRA-HIGH VACUUM CRYOPUMP WITH A LOW CONSUMPTION OF HELIUM. Lazarev, B. G.; Makarov, V. I.; San'kov, A. A.; Grishin, S. F.; Kovalenko, V. A. (Physical-Technical Inst., Kharkov). Cryogenics; 15: No. 11, 679-680 (Nov 1975).

A helium condensation pump has been used to produce extremely clean vacuum conditions in equipment used for vacuum metallurgy, in particular, for zone melting of refractory metals. This note describes the pump construction which has the lowest liquid helium consumption, compared with those described previously. The pump allowed an ultrahigh vacuum to be maintained in the device, after a single injection of liquid helium, for nearly three months at a condensing surface temperature of 4.2°K and for two months at 2.3°K. (UK)

ENVIRONMENTAL AND EARTH SCIENCES

Refer also to abstract 20239.

20181 (BNL-20701) ERDA/NATIONAL LABORATORIES WORKSHOP ON ENVIRONMENTAL EFFECTS OF ENERGY HELD AT ROCKEFELLER UNIVERSITY, NEW YORK, NEW YORK, SEPTEMBER 4-5, 1975. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. Contract E(30-1)-16. 141p. Dep. NTIS $7.00.

The important environmental impacts of energy production are summarized. A summary of these impacts associated with each step of the nuclear fuel cycle is included. (CH)

20182 EFFECT OF THERMAL POLLUTION ON THE DISTRIBUTION OF NAEGLERIA FOWLERI. De Jonckheere, J.; Van Dijck, P.; Van De Voorde, H. (Katholieke Univ., Louvain, Belgium). J. Hyg.; 75: No. 1, 7-13(Aug 1975).

The study investigates the distribution in the environment of Naegleri fowleri which is the causative agent of primary amoebic meningoencephalitis. Sampling from two canals, a stream, two lakes, several reservoirs and slow sandfilters of a water supply service and also a water distribution network resulted in the Naegleri fowleri being found in only one of the two thermally polluted canals and being absent from all the other locations. These factors indicate that other factors than high temperatures are involved in the selective proliferation of N. fowleri. Most of the strains isolated were not virulent for mice, although they showed all the characteristics of the pathogenic strains. Other amobae able to grow at 42°C were found in the sampling locations. Includes 1 table.

Minerals and Ores

Refer also to abstracts 22609, 22673, and 22674.

20183 (AEC-RID-4) MAGNETIC SUSCEPTIBILITY AND GEOCHEMICAL RELATIONSHIPS AS URANIUM PROSPECTING GUIDES. Ellis, J. R.; Austin, S. R.; Droullard, R. F. (Energy Research and Development Administration, Grand Junction, Colo. (USA). Grand Junction Office). Nov 1968. 26p. Dep. NTIS $4.00.

Select chemical and physical variables for 48 observations along a Wyoming ground traverse are compared statistically by use of a correlation program written for the IBM 1401. A comparison of the airborne gamma spectrometry with the ground data is also presented. Highly significant correlations exist between U_3O_8 or eU_3O_8 and eTh, eK, loss on ignition, and a significant correlation with combined P and V. Magnetic susceptibility has a highly significant correlation with Fe, Mn and negatively with eU_3O_8. The negative correlation with uranium offers a possible prospecting method to delineate areas favorable for uranium. (auth)

20184 (GJO-110(76)) SUBJECTIVE PROBABILITY APPRAISAL OF URANIUM RESOURCES IN THE STATE OF NEW MEXICO. Ellis, J. R.; Harris, D. P.; VanWie, N. H. (Energy Research and Development Administration, Grand Junction, Colo. (USA). Grand Junction Office). Dec 1975. 103p. Dep. NTIS $5.50.

This report presents an estimate of undiscovered uranium resources in New Mexico of 226,681,000 tons of material containing 455,480 tons U_3O_8. The basis for this estimate was a survey of expectations of 36 geologists, in terms of subjective probabilities of number of deposits, ore tonnage, and grade. Weighting of the geologists' estimates to derive a mean value used a self-appraisal index of their knowledge within the field. Detailed estimates are presented for the state, for each of 62 subdivisions (cells), and for an aggregation of eight cells encompassing the San Juan Basin, which is estimated to contain 92 percent of the undiscovered uranium resources in New Mexico. Ore-body attributes stated as probability distributions enabled the application of Monte Carlo methods to the analysis of the data. Sampling of estimates of material and contained U_3O_8 which are provided as probability distributions indicates a 10 percent probability of there being at least 600,000 tons U_3O_8 remaining undiscovered in deposits virtually certain to number between 500 and 565. An indicated probability of 99.5 percent that the ore grade is greater than 0.12 percent U_3O_8 suggests that this survey may not provide reliable estimates of the abundance of material in very low-grade categories. Extrapolation to examine the potential for such deposits indicates more than 1,000,000 tons U_3O_8 may be available down to a grade of 0.05 percent U_3O_8. Supplemental point estimates of ore depth and thickness allowed derivative estimates of cost of development, extraction, and milling. 80 percent of the U_3O_8 is estimated to be available at a cost less than $15/lb (1974) and about 98 percent at less than $30/lb. (auth)

20185 (GJO-1649) COMPARATIVE STUDY OF THE GEOSTATISTICAL ORE RESERVE ESTIMATION METHOD OVER THE CONVENTIONAL METHODS. Kim, Y. C.; Knudsen, H. P. (Arizona Univ., Tucson (USA)). 31 Aug 1975. Contract AT(05-1)-1649. 101p. Dep. NTIS $5.50.

Part I contains a comprehensive treatment of the comparative study of the geostatistical ore reserve estimation method over the conventional methods. The conventional methods chosen for comparison were: (a) the polygon method, (b) the inverse of the distance squared method, and (c) a method similar to (b) but allowing different weights in different directions. Briefly, the overall result from this comparative study is in favor of the use of geostatistics in most cases because the method has lived up to its theoretical claims. A good exposition on the theory of geostatistics, the adopted study procedures, conclusions and recommended future research are given in Part I. Part II of this report contains the results of the second and the third study objectives, which are to assess the potential benefits that can be derived by the introduction of the geostatistical method to the current state-of-the-art in uranium reserve estimation method and to be instrumental in generating the acceptance of the new method by practitioners through illustrative examples, assuming its superiority and practicality. These are given in the form of illustrative examples on the use of geostatistics and the accompanying computer program user's guide. (LK)

20186 NEEDS: NUCLEAR ENERGY ELECTRICAL DEMAND SIMULATION. Willke, T. L. (Battelle Columbus Labs., OH). Simulation; 26: No. 2, 33-42 (Feb 1976).

A computer model is presented called NEEDS—an acronym for Nuclear Energy Electrical Demand Simulation—which can simulate the nuclear sector of the United States electric power economy. The code can forecast the impact of various nuclear reactor growth patterns over the next fifty years in terms of economics, resource utilization, and the requirements for a supporting fuel-cycle industry. NEEDS was developed for the Office of Energy Research and Development Policy of the National Science Foundation as a tool to help evaluate alternative fission reactor development strategies involving advanced reactor concepts, including advanced high-temperature gas-cooled reactor (HTGR) systems, the gas-cooled fast reactor (GCFR), the molten-salt breeder reactor (MSBR), the light-water breeder reactor (LWBR), and the heavy-water reactor (HWR). The objectives of the study were to calculate the impacts, benefits, and requirements of various nuclear growth patterns and to determine the sensitivity of these measures to input parameters which are dominating, uncertain, or subject to wide variations. (auth)

20187 POTASSIUM-URANIUM RATIO IN KIMBERLITES. Komarov, A. N.; Ilupin, I. P. (Inst. of Geochronological and Geological Documents, Leningrad). Dokl. Akad. Nauk SSSR; 222: No. 5, 1210-1212(11 Jun 1975). (In Russian).

The amount of heat lost by the earth is approximately equal to the heat formed as a result of radioactive decay, if the initial composition of the earth were that of a chrondrite meteorite. However the ratio of potassium to uranium in chrondrites (7.7×10^4) differs greatly from the K-U ratio in the earth's crust (1.0×10^4). A number of kimberlite samples were analyzed for potassium by flame photometry and for uranium by counting fission tracks in synthetic phlogophite. A very low value of the potassium-uranium ratio was found both for the kimberlites (0.11×10^4) and for the picritic porphyrites (0.18×10^4). These values are significantly lower than the value of 1.0×10^4 for the earth's crust. The kimberlites are thought to be the substance from the deepest parts available at the surface of the earth. The formation depth of the kimberlites is estimated at 150 to 200 km. (SJR)

Radioactivity Monitoring and Transport

Refer also to abstracts 19666, 20468, 20578, 20917, and 22675.

20188 (BNWL-SA-5630) "FILTER-RESIN" SAMPLING METHOD FOR MEASUREMENT OF RADIOACTIVITY IN COLUMBIA RIVER WATER. Fix, J. J.; Robertson, D. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1976. 7p. (CONF-760202-26). Dep. NTIS $3.50.

From ninth topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Several radionuclides present in Columbia River water have been measured since 1973 by using a filter-resin sampler to remove most radionuclides from the water during biweekly sampling periods and by counting directly and separately the filters and resin with a high sensitivity multi-dimensional (coincidence) gamma ray spectrometer. Insoluble (collected on filters) and soluble (adsorbed onto resin) concentrations of several radionuclides are observed and used to determine the probable origin of the activity. To date, all of the observed concentrations are less than 0.01 percent of the most restrictive ERDA Manual Chapter 0524 guidelines for drinking water. (auth)

20189 (CEA-N-1820) IN SITU OBSERVATION OF PLUTONIUM TRANSFER PROCESSES IN THE MARINE ENVIRONMENT. Guary, J. C.; Fraizier, A. (CEA Centre de La Hague, 50-Cherbourg (France). Service de Recherches Toxicologiques et Ecologiques). Sep 1975. 18p. (In French). Dep. NTIS (US Sales Only) $3.50.

A preliminary observation of plutonium transfer processes in the marine environment was carried out and showed that concentration of the radionuclide was lower when marine organisms stood at a higher trophic level. This observation supplemented by an investigation on contamination pathways showed that plutonium was not concentrated along the food chain and its uptake occurred preferentially by direct contact of species with seawater, a process chiefly affecting producers and primary consumers. It appeared that the marine sediment was not a significant vector of plutonium transfer in burrowing species. (auth)

20190 (IDO-22055) HYDROLOGIC DATA FOR THE IDAHO NATIONAL ENGINEERING LABORATORY SITE, IDAHO. Barraclough, J. T.; Jensen, R. G. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Jan 1976. 52p. Dep. NTIS $5.50.

The Idaho Chemical Processing Plant (ICPP) discharges low-level waste and chemical waste directly to the Snake River Plain aquifer through a 600-foot (180 meter) disposal well. Most of the radioactivity is removed by distillation and ion exchange prior to being discharged into the well. During 1971 to 1973, the well was used to dispose of 404 curies of radioactivity, of which 389 curies were tritium (96 percent). The average yearly discharge was about 300 million gallons (1.1×10^9 liters). The distribution of waste products in the Snake River Plain aquifer covers about 15 square miles (30 square kilometers). Since disposal began in 1952, the wastes have migrated about 5 miles (8 kilometers) downgradient from discharge points. The perched ground-water body contains tritium, chromium-51, cobalt-60, and strontium-90. Radionuclides are subject to radioactive decay, sorption, and dilution by dispersion in the aquifer. Chemical wastes are subject to sorption and dilution by dispersion. Waste plumes south of the ICPP containing tritium, sodium, and chloride have been mapped and all cover a similar area. The plumes follow generally southerly flow lines and are widely dispersed in the aquifer. The waste plume of strontium-90 covers a much smaller area of the aquifer, about 1.5 square miles (4 square kilometers). Based on the relatively small size of the plume, it would appear that the strontium-90 is sorbed from solution as it moves through the Snake River Plain aquifer. (auth)

20191 (LA-6093) WATER QUALITY IN VICINITY OF FENTON HILL SITE, 1974. Purtymun, W. D.; Adams, W. H.; Owens, J. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-eng-36. 18p. Dep. NTIS $4.50.

The water quality at nine surface water stations, eight ground water stations, and the drilling operations at the Fenton Hill Site have been studied as a measure of the environmental impact of the Los Alamos Scientific Laboratory geothermal experimental studies in the Jemez Mountains. Surface water quality in the Jemez River drainage area is affected by the quality of the inflow from thermal and mineral springs. Ground water discharges from the Cenozoic Volcanics are similar in chemical quality. Water in the main zone of saturation penetrated by test hole GT-2 is highly mineralized, whereas water in the lower section of the hole, which is in granite, contains a higher concentration of uranium. (auth)

20192 RADIOACTIVE WASTES. Straub, C. P. (Univ. of Minnesota, MN). J. Water Pollut. Control Fed.; 47: No. 6, 1498-1513(Jun 1975).

A review is presented on the environmental behavior of radioactive wastes. The management of high-level wastes and waste disposal methods were discussed. Some topics included were ore processing, coagulation, absorption and ion exchange, fixation, ground disposal, flotation, evaporation, transmutation and extraterrestrial disposal. Reports were given of the ^{226}Ra, ^{224}Ra and tritium activity in hot springs, ^{90}Sr concentrations in the groundwater and in White Oak Creek, radionuclide content of algae, grasses and plankton, radionuclides in the Danube River, Hudson River, Pacific Ocean, Atlantic Ocean, Lake Michigan, Columbia River and other surface waters. Analysis showed that ^{239}Pu was scavenged from Lake Michigan water by phytoplankton and algae by a concentration factor of up to 10,000. Benthic invertebrates and fish showed higher ^{239}Pu concentrations than did their pelagic counterparts. Concentration factors are also given for ^{234}Th, ^{60}Co, Fe and Mr in marine organisms. Two models for predicting the impact of radioactivity in the food chain on man were mentioned. In an accidental release from a light-water power reactor to the ocean, the most important radionuclides discharged were found to be ^{90}Sr, ^{137}Cs, ^{239}Pu and activation products ^{65}Zr, ^{59}Fe, and ^{95}Zr. (FMM)

20193 STUDY OF THE STATE OF PLUTONIUM AND RUTHENIUM IN SEAWATER BY ULTRAFILTRATION METHOD. Gromov, V. V.; Spitsyn, V. I.; Surikov, V. V. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 316-319(1974).

Translated from Radiokhimiya; 16: No. 3, 312-316(1974).

It was found that in the surface layers of seawater the change in the effective radius of the particles containing plutonium-239 and ruthenium-106 is determined by the activity of phytoplankton. In addition to the biogenic process of extraction from seawater, adsorption capture by fine particles of the suspension is more characteristic of ruthenium. In the surface layers of water plutonium is associated with particles of larger size (60%, $0.6 < r < 1.2\mu$) than ruthenium (~10%, $0.1 < r < 1.2\mu$). (auth)

20194 TRANSIENT BEHAVIOR OF CADMIUM IN A GRASSLAND ARTHROPOD FOOD CHAIN. Van Hook, R. I.; Yates, A. J. (Oak Ridge National Lab., TN). Environ. Res.; 9: No. 1, 76-83 (1975).

Biological assimilation and transport of cadmium were determined for an arthropod food chain in an east Tennessee grassland community. Laboratory experiments demonstrated that there were no significant differences (P greater than 0.05) in assimilation rates (17 percent assimilation per day) or biological half-lives (7 days) of ^{109}Cd either as soluble nitrate or insoluble oxide in crickets under identical conditions. Field experiments demonstrated that primary consumers (crickets) accumulated ^{109}Cd much more rapidly (uptake rate equals 0.55 day^{-1}) than did the spider predators (uptake rate equals 0.08 day^{-1}). Equilibrium concentrations in crickets were obtained in 9 days (0.04 ppM cadmium), while equilibrium was not reached in spiders during the 30-day study. Food-chain concentration of cadmium did not occur as crickets accumulated levels of cadmium 60 percent of that in their vegetation food sources and spiders accumulated only 70 percent of the cadmium present in the cricket tissues. (auth)

Atmosphere

Refer also to abstracts 19663, 20237, 20281, 22331, 22354, 22514, and 22669.

20195 (ANL-75-60(Pt.2), pp 146-148) USE OF A MICROPROCESSOR IN A REMOTE WORKING LEVEL MONITOR. Keffe, D. J.; McDowell, W. P.; Groer, P. G. 1975.

In Radiological and Environmental Research Division annual report, July 1974-June 1975. (Argonne National Lab., Ill. (USA)).

A remote working level monitor was designed to measure short-lived radon-daughter concentrations in sealed chambers having potentially high radiation levels (up to 2000 WL). The system is comprised of surface barrier detectors, multiplexer and buffers, microprocessor and teletype. (SFL)

20196 (UCRL-77572) ARAC SYSTEM. Kelly, M. F.; Wyman, R. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1975. 5p. (CONF-760105-1). Dep. NTIS $3.50.

From 9th Hawaii international conference on system sciences; Honolulu, Hawaii, United States of America (USA) (6 Jan 1976).

In spite of the remarkable safety record of the nuclear industry as a whole, recent public concern over the potential impact of the industry's accelerated growth has prompted ERDA to expand its emergency response procedures. The Atmospheric Release Advisory Capability, ARAC, is a computer communications system designed to enhance the existing emergency response capability of ERDA nuclear facilities. ARAC will add at least two new functions to this capability: centralized, real-time data acquisition and storage, and simulation of the long range atmospheric transport of hazardous materials. To perform these functions, ARAC employs four major sub-systems or facilities: the site facility, the central facility, the global weather center and the regional model. The system has been under development for the past two years at the Lawrence Livermore Laboratory of the University of California. (auth)

20197 SOME OBSERVATIONS BASED ON THE MEASUREMENTS ON FRESH FALLOUT FROM THE RECENT CHINESE AND FRENCH NUCLEAR EXPLOSIONS. Mishra, U.C.; Lalit, B.Y.; Sethi, S.K.; Shukla, V.K.; Ramachandran, T.V. (Air Monitoring Section, Bhabha Atomic Research Centre, Bombay, India). J. Geophys. Res. 80: No. 36, 5045-5049 (20 Dec 1975).

China conducted its sixteenth nuclear explosion (fifteenth in the atmosphere) at Lop Nor (40°N, 90°E) on June 17, 1974. France also started its 1974 test series of nuclear explosions on the same date in the southern hemisphere near Mururoa Atolls (22°S, 139°W). Radioactive fallout samples from some of these nuclear explosions were collected by swiping certain exposed portions of the aircraft flying between Tokyo/Ōsaka and Bombay, New York and Bombay (for the Chinese test), and Sydney and Bombay (for the French tests). This paper gives some of our observations based on these studies for samples collected between June 15, 1974, and July 30, 1974. The study involved measurement of a number of radionuclides, i.e., ^{89}Sr, ^{99}Mo, ^{111}Ag, ^{132}Te, ^{140}Ba, ^{237}U, ^{239}Np, etc. The observed activity ratios for some selected pairs of radionuclides have been interpreted in terms of fissile material used in the device and the type of explosion. (auth)

20198 POLYMERIC SEALANTS MAY PROVIDE EFFECTIVE BARRIERS TO RADON GAS IN URANIUM MINES. Franklin, J. C.; Bates, R. C.; Habberstad, J. L. (USBM Spokane Mining Research Center, WA). Eng. Min. J.; 176: No. 9, 116-118(Sep 1975).

Of the 46 coating materials tested on uranium ore samples, three were found to be 100 percent efficient as radon barriers and 22 materials were judged at least 50 percent efficient. Toxicity, flammability, adhesion to wet and dry rock, and cure rate in a minelike environment were evaluated to screen out unacceptable materials. Four of the overall best coatings (a latex, an unsaturated polyester, and two water-based epoxies) were tested in an underground uranium mine in the Ambrosia Lake district of New Mexico to evaluate their sprayability and their in-place barrier efficiency. The coatings exhibited good sprayability, adhesion, and curing in the mine. Radon gas emanation was reduced by 60 percent in one chamber and by 62 percent in the other. (LK)

20199 ATMOSPHERIC CONCENTRATIONS AND INVENTORY OF ^{85}Kr IN 1973. Telegadas, K.; Ferber, G. J. (National Oceanic and Atmospheric Administration, Silver Spring, MD). Science; 190: No. 4217, 882-883(28 Nov 1975).

Measurements of the concentrations of ^{85}Kr in the atmosphere were made in 1973 between 1.5 and 20 kilometers. The global inventory of ^{85}Kr for 1973 calculated from these data is 53 megacuries. The stratospheric distribution of ^{85}Kr concentrations shows a maximum in the lower equatorial region of each hemisphere and a minimum concentration in the polar regions. This distribution tends to confirm the mean stratospheric circulation as deduced from other radioactive tracer data. Both ^{85}Kr and Fluorocarbon-11 (CCl_3F, here designated as F-11) are inert gases released principally into the surface air in the temperate latitudes of the Northern Hemisphere. The stratospheric distribution of ^{85}Kr is very similar to that of F-11. Above 20 kilometers a photodissociation of fluorocarbons may take place, producing atomic chlorine which may act as a catalyst in the destruction of stratospheric ozone. Since ^{85}Kr has no known significant sinks and its half-life is known, measurements of the concentration of both of these gases above 20 kilometers may provide insight regarding the rate of dissociation of F-11. (auth)

Soil

Refer also to abstracts 20187, 20921, and 20925.

Water

20200 ENVIRONMENTAL ANALYSIS OF NUCLEAR MERCHANT SHIP OPERATION. Englehart, R. W. (NUS Corp., Rockville, MD). Trans. Am. Nucl. Soc.; 22: 105-106(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Ecosystems and Food Cycles

Refer also to abstracts 20491, 20533, and 20569.

20201 HYPOTHETICAL RADIATION DOSE FROM TRITIATED OIL SHALE GASOLINE. Sweeton, F. H.; Barton, C. J. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 2-3(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Radiometric Techniques

Refer also to abstracts 20188 and 20326.

20202 (LBL-4445) INVESTIGATION OF RADON-222 IN SUBSURFACE WATERS AS AN EARTHQUAKE PREDICTOR. Smith, A. R.; Bowman, H. R.; Mosier, D. F.; Asaro, F.; Wollenberg, H. A.; King, C. Y. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 15p. (CONF-751116-28). Dep. NTIS $3.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

Changes of radon-222 content of well waters in seismically active regions may provide earthquake precursor signals, according to reports of recent Chinese and Russian work. A high-precision gamma-ray system for continuous monitoring of radon in wells and springs has been developed at the Lawrence Berkeley Laboratory, where monitoring began in April 1975, and has been extended to other sites including the San Andreas fault zone. (auth)

20203 STATISTICAL ERRORS IN BETA ABSORPTION MEASUREMENTS OF PARTICULATE MASS CONCENTRATION. Cooper, D. W. (GCA, Bedford, MA). J. Air Pollut. Control Assoc.; 25: No. 11, 1154-1155(Nov 1975).

In instruments using beta radiation to determine an even smaller particulate mass concentration, the initial and final counts are becoming increasingly closer in magnitude and the errors in both should be considered. Error expressions are derived for the initial and final counts. (LK)

Site Surveys

Refer also to abstract 20173.

20204 (NERC-LV-539-29) TISSUE BURDENS OF SELECTED RADIONUCLIDES IN BEEF CATTLE ON AND AROUND THE NEVADA TEST SITE. Smith, D. D.; Black, S. C.; Giles, K. R.; Bernhardt, D. E.; Kinnison, R. R. (Environmental Protection Agency, Las Vegas, Nev. (USA). Environmental Monitoring and Support Lab.). Jan 1976. Contract AT(26-1)-539. 90p. Dep. NTIS $5.45.

During 1972, cattle from three different herds on and around the Nevada Test Site were sampled to determine the tissue burdens of plutonium and uranium. The only other isotopes detected in tissues were ^{90}Sr, ^{131}I, ^{137}Cs, and ^{3}H, although ^{95}Zr, ^{103}Ru, ^{140}Ba, and ^{141}Ce were frequently found in rumen contents. The herds sampled were: a control herd from Searchlight, Nevada; a herd from Area 18, the Nevada Test Site; and a herd grazing in the Operation Roller Coaster Area of the Tonopah Test Range, where four chemical detonations involving plutonium were conducted in 1963. (auth)

Thermal Effluents

Refer also to abstracts 20242, 21991, 22475, and 22476.

20205 COMPARISON OF FOOD HABITS OF WHITE PERCH (MORONE AMERICANA) IN THE HEATED EFFLUENT CANAL OF A STEAM ELECTRIC STATION AND IN AN ADJACENT RIVER SYSTEM. Moore, C. J.; Fuller, S. L. H.; Burton, D. T. (Benedict Estuarine Research Lab., MD). Environ. Lett.; 8: No. 4, 315-323 (1975).

Analysis of the stomach contents of 97 white perch, Morone americana, taken from the effluent canal of a steam electric station (S.E.S.) and 106 white perch from adjacent Patuxent River waters indicated similar food habits from September 1970 through August 1971. However, 35 percent of all white perch taken from the heated effluent canal contained small pieces of coal and cinders, whereas only 3 percent of the river specimens contained such items in their stomachs. Fly ash and coal dust are present on the bottom of the S.E.S. canal, whereas little such material, if any, can be found on the river bottom in the study area. This suggests the canal fish were actively feeding in the heated effluent and not simply moving into the canal after feeding in the river. No significant difference (P greater than 0.05) was found between the average wet weight stomach contents of the river and canal fish within the same month. (auth)

20206 WATER FOR THE HUMAN ENVIRONMENT. Volume IV. Special Sessions. Proceedings of the First World Congress on Water Resources, Chicago, Illinois, September 24-28, 1973. Chow, V. T.; Csallany, S. C.; Krizek, R. J.; Preul, H. C. (eds.). Champaign, IL; International Water Resources Association (1973). 557p. (CONF-7309143-P4).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973).

Fifty papers were presented. Twenty-one papers on thermal pollution were separately abstracted and indexed for Nuclear Science Abstracts. One paper was abstracted for ERDA Research Abstracts. Other subjects covered included industrial and municipal waste management, water quality monitoring and resource management for recreational uses. (PCS)

For abstracts of individual papers see: 20207–20225, 20239, and 20240.

20207 INSTABILITY OF WATER COOLED FROM ABOVE. Snider, D. M.; Viskanta, R. (Purdue Univ., West Lafayette, IN). pp 3-14 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

The temperature field and convection currents induced in water by convection, evaporation and radiation cooling of its surface were studied. These phenomena occur naturally and continuously in any lake, pond, reservoir or a river but they remain usually unobserved. Mach–Zehnder interferograms taken from the side of a tank of water are here used to measure the temperature distribution and to study the convective currents induced by cooling from the surface. Experiments were performed with initially uniform and thermally-stratified layers of water. Both qualitative and quantitative results of preliminary nature for temperature distribution are presented. Interferograms vividly reveal mixing motions induced by instabilities arising in the surface layer. The onset of manifest convective behavior was determined by visual observations of interferograms. (auth)

20208 ANALYTICAL MODEL FOR A HEATED SUBMERGED DISCHARGE INTO BREAK WATER WALL AREA. Jaisinghani, R. A.; Shah, V. L.; Tsao, K. C. (Univ. of Wisconsin, Madison). pp 15-31 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

In order to obtain the temperature distribution due to a submerged heated discharge in a shielded area of water, a study of three-dimensional rectangular submerged turbulent buoyant jet has been made. After transforming the conservation equations of mass, momentum and energy, from the Cartesian coordinates to the coordinates suitable for the deflected jet, the equations are integrated by assuming velocity and temperature profiles across the cross section. The entire jet can then be investigated by solving simultaneously a set of algebraic equations and by marching forward step by step. (auth)

20209 EVALUATION OF WATER TEMPERATURE FIELDS RESULTING FROM HEATED WATER DISCHARGES. Stefan, H.; Skoglund, T. (Univ. of Minnesota, Minneapolis). pp 32-47 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

Evaluation of the physical effects of cooling water discharges into an aquatic environment must provide information on at least four aspects of the problem: steady-state temperature distribution downstream of the outfall for various seasonal conditions, frequency and amplitude of hourly and daily transitory temperature characteristics, temperature versus residence-time relationships for various flow paths, and modifications of overall temperature levels through heat budget and stratification. Information presented in the temperature-area-time frame is useful for biological interpretation. Illustrations using four different cooling water outfalls in the Upper Mississippi River basin are presented. (auth)

20210 DESIGN AND MODEL TESTS OF THERMAL DISCHARGE DIFFUSERS. Tallis, J. A. (Sudesco Systems Inc., Buffalo). pp 48-61 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

The paper describes two specific aspects of thermal hydraulic model simulation and indicates how the results obtained from the study of a particular thermal discharge are applicable to other design situations. First, the use of an undistorted, two-dimensional model for investigating in detail the flow and mixing characteristics of a thermal discharge diffuser is discussed. Second, methods for calibrating distorted scale models to provide satisfactory prototype simulation are detailed. Guidelines for the initial design of a diffuser structure are presented. (auth)

20211 THERMAL POLLUTION PROBLEMS IN POLAND. Dojlido, J. (Inst. of Meteorology and Water Economy, Warsaw). pp 70-75 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

The power plants projected for Poland's energy needs of the future have encouraged broad research on environmental impacts expected from the waste heat discharged. A large amount of data has been collected to enable mathematical predictions of future water quality. (PCS)

20212 TWO DIMENSIONAL TRANSIENT HYDRO-THERMAL MATHEMATICAL MODEL. Tsai, Y. J.; Chang, Y. C. (Stone and Webster Engineering Corp., Boston). pp 76-88 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

The heat conservation equation in two horizontal dimensions with the equations of motion and continuity in vertically integrated form are solved for the spatial transient temperature rises in a body of water due to thermal discharge of artificial origin. Flow patterns and water level variations induced by the plant intake and discharge, stream inflow and outflow, meteorological parameters, and tidal agitation can be obtained from the mathematical model. The multioperational method (alternate direction implicit) used in the solution for the finite difference equations of the governing partial differential equations is unconditionally stable and appears economical. The model makes it possible to investigate environmental design considerations in conjunction with cooling system alternatives, plant operating modes, and hydrological and meteorological conditions, and to minimize the effects of thermal discharges to the environment. A case-study is presented in which a multiport submerged diffuser is employed. The hydrothermal condition which prevails in the study area is numerically simulated and the results are depicted in computer-plotted graphs. (auth)

20213 SOME RESULTS FROM EXPERIMENTAL DATA ON SURFACE JET DISCHARGE OF HEATED WATER. Shirazi, M. A. (National Environmental Research Center, Corvallis, OR). pp 89-108 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

Published laboratory and field data on heated surface jets are compiled from several sources and presented in a unified and easily usable format. Partial analysis of the data is presented to show the general influences of the (a) ambient current, (b) the initial discharge angle (c) the jet densimetric Froude number and (d) the jet aspect ratio on the plume trajectory, plume half-width and centerline temperature. The plots are qualitative in nature, subject to refinement when better data become available. Meanwhile, they can be very helpful in the development of mathematical models for surface jets. (auth)

20214 DRY-TYPE COOLING SYSTEMS IN ELECTRIC POWER PRODUCTION. Li, K. W. (North Dakota State Univ., Fargo). pp 109-119 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

This study indicates that the dry-type cooling tower could be adopted in this country as an alternative method for removing waste heat from power plants. The use of dry cooling towers would not only lead to a change of cooling system design, but also to a change of overall thermal design in a power generating system. The principal drawbacks to using dry cooling towers in a large steam-turbine plant are the generating capacity loss, increased fuel consumption and the high capital cost of the dry cooling towers. These economic penalties must be evaluated in each specific case against the benefits that may result from the use of dry cooling towers. The benefits are principally these: (1) Fewer constraints in the selection of power plant sites, (2) No thermal discharge to the natural water bodies, (3) Elimination of vapor plumes and water evaporation loss, and (4) Freedom of adding new units to an existing facility where inadequate water supply may otherwise rule out this possibility. (auth)

20215 COOLING POND TEMPERATURE PREDICTION. Graves, W. L. Jr. (Towson State College, Baltimore). pp 120-132 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

A model is described which predicts temperature responses in the environment that are associated with the operation of a natural gas fueled thermoelectric power generation station. The model is a piecewise computer simulation, limited at present to closed cooling water systems. However, the techniques developed should be applicable to a much larger class of cooling system. The problem encountered consists of two parts: (1) data characterization and (2) modeling. An efficient characterization scheme for the environmental variables greatly simplifies the task of modeling. Methods borrowed from signal theory, but not yet applied to this field are applicable to and greatly simplify the digital computer investigation of environmental data. An optimal data set, from the point of view of information per unit cost, is described for the model. (auth)

20216 DEMONSTRATION OF WASTE HEAT USE IN AGRICULTURE. Christianson, A. G. (Environmental Protection Agency, Corvallis, OR); Berry, J. W.; Miller, H. H. Jr. pp 142-153 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

This project has demonstrated specific methods of using warmed condenser cooling water for agricultural purposes. For some applications, i.e., irrigation and plant cooling, such water does not offer significant benefits which can be attributed to its elevated temperature alone; conversely, no damage need be incurred. For frost protection, warm water offers advantages over water at normal temperatures. Warm water use for underground soil heating, in open fields and under greenhouses, shows significant potential for profitable use for selected crops which demonstrated increased yields. (auth)

20217 SOME BIOLOGICAL ASPECTS OF AQUATIC THERMAL DISCHARGES. Merriman, D. (Yale Univ., New Haven). pp 154-164 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

The general introduction deals with aquatic ecology and thermal effects, industrial and natural. The specific case of the operation of the Connecticut Yankee Atomic Power Company plant is discussed —a documented pre- and post-operative study (1965–1972) of the ecosystem. Pertinent problems of entrainment and the passage of anadromous fishes are outlined, and the conclusion points to the matters of plant siting and the achievement of rational balance between the desirable ecology and the necessary economy. (auth)

20218 COMBINED SYSTEM CONCEPT FOR POWER GENERATION AND WASTEWATER RENOVATION. Fazzolare, R. A.; Sierka, R. A. (Univ. of Arizona, Tucson). pp 180-185 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Waster Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

A power plant-wastewater treatment system complex is proposed in which waste heat is used in the treatment process, condenser cooling is provided, and there is a net production of reusable water. Wastewater contaminants are removed by the simultaneous addition of a metal coagulant and activated carbon in a one-step operation at elevated temperatures. (auth)

20219 DESIGN OF THERMAL COOLING SYSTEMS USING THE CASCADE OF ENERGY CONCEPT. Harden, D. G. (Univ. of Oklahoma, Norman). pp 186-193 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

A cascade system of energy usage recognizes that energy needs occur at different potential levels and attempts to maximize the useful effects for man of energy flows. An energy cascade system can be designed most logically by starting with those uses which have outlet conditions at or near the lowest naturally accessible potentials and then inserting appropriate energy utilization devices which utilize no more of the existing potential than necessary. The cascade method is the reverse of the normal design method. Several illustrations of the cascade type of design are discussed. (auth)

20220 REVIEW OF HEATED SURFACE DISCHARGE MODELS APPLICABLE TO RIVERS. Benedict, B. A.; Jones, L. T. (Vanderbilt Univ., Nashville). pp 194-203 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

A review of currently available mathematical models for heated water surface discharges yields four which seem especially applicable to river systems. Models selected include one jet model, by MOTZ and BENEDICT (1970), and three diffusion models: the Cornell version of the Brooks diffusion model, by SUNDARAM, et al (1969); and the two-dimensional and three-dimensional models presented by EDINGER and POLK (1969). In addition, the data from CARTER (1973) shows promise but has a very limited range of applicability. For each model generalized, nondimensional solutions are developed in graphical form with the quantities of surface area, longitudinal distance, and lateral distance shown plotted against temperature rise. Comparison of the models for a hypothetical case is carried out. Model comparisons generally show no great difference between two-dimensional and three-dimensional models. The jet model in the study gives results that are similar to those of the diffusion models. These inconsistencies do give directions for future work in these areas. (auth)

20221 MATHEMATICAL MODELLING AND IDENTIFICATION OF THERMAL POLLUTION IN STREAMS: A REVIEW PAPER. Foley, J. W.; Cardenas, M. A.; Haimes, Y. Y. (Case Western Reserve Univ., Cleveland). pp 204-216 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

The determination of both model topology and parameters was analyzed under different assumptions. Generalized strategies for ranking the effectiveness of alternative parameter identification approaches were presented. The first assumes an input-output philosophy to identify parameters, while the second attempts to correlate and directly measure more basic variables or parameters related to the physical systems. Alternative strategies were presented where a trade-off exists between simplicity versus data need and computational sophistication. Computer structuring of data generation and identification-ranking schemes which can complement more traditional model and parameter estimation procedures was described. (PCS)

20222 THERMAL POLLUTION OF THE GREAT LAKES: A NONPROBLEM. Gustafson, P. F. (Argonne National Lab., IL). pp 217-223 of Water for the Human Environment, Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

Research of recent years on Lake Michigan to determine natural and man-made thermal distributions and their effects on the biota of the lake has not shown any unacceptable biological effects due to thermal discharges. The studies of man-made inputs centered around both fossil- and nuclear-fueled steam generating plants with comparative studies in and around the Grand River inflow. The author discusses the use of cost-benefit analysis as related to cooling system design for power plants. (PCS)

20223 MECHANICS OF DISPERSION OF POLLUTANTS IN COASTAL ENVIRONMENT. Jordaan, J. M. Jr. (Dept. of Water Affairs, Orania, South Africa). pp 307-318 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

The relationships between energy dissipation (turbulence) and mixing and analogy with classical diffusion theory are reviewed. Typical solutions of the differential equations, for various initial and boundary conditions related to practical cases are presented. The natural processes that control the dispersion in the nearshore regions were studied in a wind-wave channel and in the field and interpretive conclusions are drawn on the practice of nearshore disposal of effluents. (auth)

20224 DEVELOPMENT OF A COMPLETE MATHEMATICAL MODEL FOR DESCRIBING THE POINT BEACH NUCLEAR POWER PLANT THERMAL PLUME. Wu, D. S.; Gallagher, B. J. (Limnetics, Inc., Milwaukee). pp 319-336 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

This paper presents a method for simulating the Point Beach Nuclear Power Plant thermal plume. Complete mathematical

models have been developed to cover both the near field and the far field regions. Existing near field models (Stolzenbach and Harleman's model and Prych's model) have been integrated to the far field by solving the diffusion equation and taking the predicted conditions at the end of the near field models as the boundary conditions for the far field models. Fourier Cosine transforms have been applied for the far field solutions. The two fields are connected through the consideration of the plume centerline velocity. A simple correction of shoreline effect has been attempted. (auth)

20225 HEAT DISSIPATION FROM TURBULENT OPEN CHANNEL FLOW. Mayer, P. G.; Moss, M. D. (Georgia Inst. of Tech., Atlanta). pp 492-499 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

Present engineering practices accomplish the rejection of excess heat by means of cooling towers and cooling ponds. The advantage of using turbulent open channel flow for heat dissipation is proposed. An examination is made in terms of increased thermal transport due to an increased surface temperature from mixing near the surface in turbulent open channel flow. A determination of the additional thermal transfer to be obtained by mixing is suggested in terms of the evaporative cooling (longwave radiation term also affected) as a function of surface temperature increase. Work is in progress to relate this phenomenon to design parameters. (auth)

20226 DETERMINATION OF AMBIENT WATER TEMPERATURES BASED ON PREOPERATIONAL ENVIRONMENTAL MONITORING DATA. Zaimis, G. M. (Philadelphia Electric Co.). Trans. Am. Nucl. Soc.; 22: 630-631(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20227 EFFECT OF THERMAL POLLUTION ON THE DISTRIBUTION OF NAEGLERIA FOWLERI. De Jonckheere, J.; Van Dijck, P.; van de Voorde, H. (Catholic Univ., Leuven, Belgium). J. Hyg.; 75: No. 7, 7-13(1975).

The distribution in the environment of Naegleria fowleri, the causal agent of primary amoebic meningoencephalitis has been investigated in this study. N. fowleri was isolated only from a thermally polluted canal. These amoebo-flagellates were not isolated from another thermally polluted canal in the neighborhood indicating that, apart from high temperature, other factors are involved in the selective proliferation of N. fowleri. This species was absent in all other samples originating from two canals, a stream, two lakes, several reservoirs and slow sandfilters of a water supply service and also a water distribution network. Many other amoebae able to grow at 42°C were found in different places. Most of the N. fowleri strains isolated were not virulent for mice, although they showed all the characteristics of the pathogenic strains. (auth)

20228 RAPID COASTAL BOTTOM WATER TEMPERATURE RISES. Highley, P. D. (Raytheon Oceanographic and Environmental Services, Portsmouth, RI); Cook, D. O. J. Environ. Eng. Div., Am. Soc. Civ. Eng.; 100: No. EE4, 955-961(Aug 1974).

Rapid 5°F to 15°F increases of normally stable water temperature at depths of 63 to 76 ft in Nahant Bay, Massachusetts, were observed in summer 1972. These rises, occurring in a few hours and persisting for several days, were apparently caused by temporary replacement of preexisting cooler bottom water by warm surface water transported into the bay by northeast winds. Weather records indicate that these events occur an average of 3/yr between June and Sept. when vertical temperature gradients occur. Rapid bottom water temperature rises are significant because of potential deleterious effects on heated effluent diffusion and on efficiency of circulating water cooling systems. The possibility of rapid bottom water temperature rises should be considered when locating and designing offshore outfall and circulating water intake structures. (Pollut. Abstr.)

20229 DISSOLVED GAS SUPERSATURATION AND DILUTION IN THERMAL PLUMES FROM STEAM ELECTRIC GENERATING STATIONS. Lee, G. F.; Martin, P. H. (Univ. of Texas, Dallas). Water Res.; 9: No. 7, 643-648(Jul 1975).

The use of natural waters for waste heat dissipation for steam electric generating stations using once-through cooling, creates potential problems of dissolved gas supersaturation in the thermal discharge plume for fish that can reside in the plume. Computations are presented which show the amount of dissolved gas supersaturation that would be expected in thermal discharge plumes employing offshore high velocity discharge and onshore low velocity discharge. It is predicted that dissolved gas supersaturation problems would be rare for steam electric generating stations utilizing high velocity offshore discharge for cooling water/heat dissipation because of the rapid dilution that occurs in the discharge plume. However, problems of this type would be expected for low velocity discharges. It is also shown that the rate of dilution from high velocity discharges would tend to minimize the environmental impact of chemicals (such as chlorine) used for condenser fouling control. (auth)

20230 TEMPERATURE EFFECTS ON GREAT LAKES WATER BALANCE STUDIES. Meredith, D. D. (State Univ. of New York, Buffalo). Water Resour. Bull.; 11: No. 1, 60-68(Feb 1975).

Beginning of month water temperature profiles are estimated for each lake. These water temperature profiles along with surface water temperatures are used to determine the effects of thermal expansion and contraction of water on the net basin supply values obtained from water balance studies using end of month lake levels. It is demonstrated that net basin supply values (equivalent to precipitation on the lake minus the evaporation from the lake plus the runoff into the lake) obtained from water balance studies without accounting for the thermal expansion and contraction of water may be in error by as much as 100 percent during some months for each lake. (auth)

20231 EFFECTS OF TEMPERATURE AND SALINITY ON FERTILIZATION, EMBRYONIC DEVELOPMENT, AND HATCHING IN BAIRDIELLA ICISTIA (PISCES:SCIAENIDAE), AND THE EFFECT OF PARENTAL SALINITY ACCLIMATION ON EMBRYONIC AND LARVAL SALINITY TOLERANCE. May, R. C. (Hawaii Inst. of Marine Biology, Kaneohe). Fish. Bull.; 73: No. 1, 1-22(Jan 1975).

Salinities of 10 ppt and below completely blocked fertilization in laboratory-matured BAIRDIELLA ICISTIA perhaps due to a low level of spermatozoan activity. Successful embryonic development occurred between 20 and 30 centigrade degrees and between 15 and 40 ppt salinities. Production of viable larvae was optimal at about 24.5 C and 26.6 ppt salinity. Development at high salinities was most successful at low temperatures and development at high temperatures was most successful at low salinities. Egg viability depended on stage of maturity of the spawning female as well as on temperature and salinity. Salinity tolerance of eggs from adult bairdiella matured sexually in dilute seawater at 15 ppt salinity was unaltered.

20232 EMBRYONIC DEVELOPMENT, EARLY GROWTH, AND MERISTIC VARIATION IN RAINBOW TROUT (SALMO GAIRDNERI) EXPOSED TO COMBINATIONS OF LIGHT INTENSITY AND TEMPERATURE. Kwain, W. H. (Ontario Ministry of Natural Resources, Marie). J. Fish. Res. Board Can.; 32: No. 3, 397-402 (Mar 1975).

Lowest mortality rates of rainbow trout (Salmo gairdneri) embryos were obtained at temperatures of 7 and 10 C and light intensities of 0.2 and 20 lx. Temperatures of 3 and 15 C and an intensity of 400 lx were near the thresholds for development. Eggs exposed to 0.2 lx required 111 days to reach 50% hatch at 3 C, but 26 days at 15 C; those exposed to 20 lx, 97 days at 3 C and 25 days at 15 C. Growth rates of rainbow trout 145 days after hatch were significantly different ($P < 0.05$) at 10 and 3 C, and 20, 2, and 0.2 lx. The fastest growth occurred at 10 C and 2 lx, and the lowest growth at 3 C and 0.2 lx. For increment of body weight it was about 23.8%/day of initial weight and 6.6% at 3 C. At light intensities of 20, 2, and 0.2 lx, the rate per day was 24.7, 17.2, and 11.2%, respectively. However, increases in length occurred at a much reduced rate. Variations in numbers of vertebrae, gill rakers, and fin rays were positively correlated with the embryonic development rate. Longer incubation periods were usually associated with more meristic elements, regardless of the environmental factors involved. (auth)

20233 REEVALUATION OF THE COMBINED EFFECTS OF TEMPERATURE AND SALINITY ON SURVIVAL AND GROWTH OF BIVALVE LARVAE USING RESPONSE SURFACE TECHNIQUES. Lough, R. G. (Oregon State Univ., Corvallis). Fish. Bull.; 73: No. 1, 86-94(Jan 1975).

The combined effects of temperature and salinity on larval survival and growth of Crassostrea virginica, Mercenaria mercenaria, and Mulinia lateralis as reported in the literature were critically examined using response surface techniques. The late veliger larvae generally have a greater tolerance to both temperature and salinity than the developing embryos. Each species shows its own characteristic change in temperature-salinity tolerance as it develops and approaches the range normally tolerated by the adults as it matures. Maximum growth of the veliger larvae required higher temperatures and somewhat higher salinities than maximum survival. Differences in temperature-salinity ranges estimated for maximum survival and growth were significantly different for all three species. In each case growth showed a significant temperature-salinity interaction. Response surface plots are given for early larval survival and

late veliger survival and growth. Inferences of tolerance studies are made to the fields of pollution and aquaculture. (auth)

20234 IMPACT OF THERMAL EFFLUENT FROM A STEAM-ELECTRIC STATION ON A MARSHLAND NURSERY AREA DURING THE HOT SEASON. Carr, W.E.S. (Univ. of Florida at Marineland, St. Augustine); Giesel, J. T. Fish. Bull.; 73: No. 1, 67-80(Jan 1975).

Of 48 species from 23 families of fish collected during the hot season from 3 similar marshland creeks, 37 were from the creek remaining at ambient temperature control while 30 species were collected in the creek receiving thermal effluents directly from a steam- electric station. Effluents entered a third creek on the initial stage of each rising tide. Numbers and biomass per unit area of juveniles of commercially utilizable species (all collected were juvenile) for the entire season in the warmed creeks were 3- to 10-fold smaller than those from the control creek. The creek receiving the effluents directly supported juveniles of utilizable species to 19 percent of its numbers and 32 percent of its biomass while the control supported 73 percent and 83 percent respectively. The majority of juveniles of the utilizable species in the warmed creeks was comprised of two species of mullet (MUGIL CUREMA AND M. CEPHALUS) while large numbers of juveniles of the utilizable species (in order of decreasing abundance) MENIDIA BERYLLINA, LEIOSTOMUS XANTHURUS, BREVOORTIA TYRANNUS, BAIRDIELLA CHRYSURA and OPISTHONEMA OGLINUM occupied the control creek in addition to the mullets.

20235 CLIMATIC BARRIERS TO LONG-TERM ENERGY GROWTH. Schneider, S. H.; Dennett, R. D. (National Center for Atmospheric Research, Boulder, CO). Ambio; 4: No. 2, 65-74(1975).

The present state of knowledge of climate theory and modeling is discussed, and it is concluded that thermal pollution from continued energy growth, together with the potential warming from a doubling of atmospheric carbon dioxide, could result in global climatic changes greater than any that have occurred since the last ice age. They warn, however, that present estimates are uncertain and could even be underestimated. The authors point out that while "unnatural" energy sources (eg fossil fuels, nuclear power and—someday—fusion power) introduce heat into the atmosphere that would not otherwise be present, the tapping of natural energy flows (eg wind, water and solar power) may not require adding heat pollution to the environment, and may thus be an attractive alternative. (auth)

20236 THERMAL EFFECTS. Coutant, C. C.; Talmage, S. S. (Oak Ridge National Lab., TN). J. Water Pollut. Control Fed.; 47: No. 6, 1656-1711(Jun 1975).

The 1974 literature on the effects of temperature on aquatic organisms was reviewed under the headings: reviews; power plant studies; producers; consumer reproduction, development, morphology, distribution, thermal tolerance, oxygen metabolism, growth, feeding, temperature and stresses, temperature selection and avoidance, activity; diseases; and beneficial uses. Many of the studies are summarized in tabular form. 453 references.

Chemical Effluents

Refer also to abstract 20190.

20237 (BNWL-B-455) MASTER SCHEDULE FOR CY-1976 HANFORD ENVIRONMENTAL SURVEILLANCE ROUTINE PROGRAM. Blumer, P. J.; Myers, D. A.; Fix, J. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1975. 38p. Dep NTIS $4.00.

Tables are presented to show the current schedule of data collection for the routine environmental surveillance program at the Hanford Reservation as conducted by the Environmental Evaluation Section of Battelle. The environmental surveillance program objectives are to evaluate the levels of radioactive and nonradioactive pollutants in the Hanford environs and to monitor Hanford operations for compliance with applicable environmental criteria given in ERDAM-0524 and Washington State Water Quality Standards. Schedules are given for the following: air, Columbia River, Sanitary water, surface water, ground water, foodstuffs, wildlife, soil and vegetation, external radiation measurement, portable instrument surveys, and waste disposal sites. (HLW)

20238 (UCRL-51949) METHODOLOGY FOR IMPACT ASSESSMENT IN THE ESTUARINE/MARINE ENVIRONMENT. Haven, K. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1975. Contract W-7405-Eng-48. 45p. Dep. NTIS $4.00.

Impacts on the estuarine/marine environment can be assessed in economic terms by tracing the impact flow out of the economic sector through the marine environment and back into the economic sector as changes in natural resource availability. An impact can then be measured by the changes created in the economic sector by changes in resource availability. Primary emphasis is placed on the development of an appropriate ecological model of the estuarine environment for this purpose. Two types, an ecological input/output model and a dynamic (difference equation) model, are proposed. Acceptability criteria for these models include the ability to track lethal and sublethal, direct and indirect (food web), and short- and long-term effects of a variety of pollutants related to the production and use of various energy resources. (auth)

20239 COOLING TOWERS: BEST ACHIEVABLE THERMAL POLLUTION ABATEMENT TECHNOLOGY. Parker, F. L.; Jernigan, E. B. (Vanderbilt Univ., Nashville). pp 133-141 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

The use of benefit-cost analyses to aid in decision making is an established practice in water resources engineering. Failure to apply an extensive benefit-cost analysis to the alternatives for controlling thermal releases from the Tennessee Valley Authority's Browns Ferry Nuclear Plant clearly resulted in an incorrect and very expensive decision. (auth)

20240 THERMAL POLLUTION ASPECTS IN EUROPE. Guli, F. P. (Ente Nationale per l'Energia Elettrica, Florence). pp 165-179 of Water for the Human Environment. Volume IV. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P4.

Current energy consumption in Europe and recent forecasts in total energy requirements are reported. Cooling potential for conventional steam electric and nuclear power production of European freshwater rivers, lakes and ponds are being assessed and based on five indexes for each country. The indexes are power density, sea coastal availability, freshwater disposability I and II, and the thermal discharge loading. These indexes though do not represent a real situation but do allow a preliminary cognizance of power development, present or future, to the parameters such as superficial flows, country area and sea coastal length for each country. Effects of thermal discharge on environment are discussed. Factors affecting the temperature distribution of a heated discharge are summarized. Once-through cooling and closed cycle system with cooling tower operating characteristics is compared. A general discussion on the desirability of coordination of standards, rules and laws in Europe is becoming increasingly urgent on thermal and air pollution. (auth)

20241 EMERGENCY RESPONSE CAPABILITY FOR POLLUTANT RELEASES TO STREAMS AND RIVERS. Buckner, M. R.; Hayes, D. W.; Watts, J. R. (Savannah River Lab., Aiken, SC). Trans. Am. Nucl. Soc.; 22: 104-105(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20242 DESIGN OF THE OPTIMAL OUTFALL SYSTEM FOR A STREAM RECEIVING THERMAL AND ORGANIC WASTE DISCHARGES. Lin, S. H.; Fan, L. T.; Hwang, C. L. (Kansas State Univ., Manhattan). Water Res.; 9: No. 7, 623-630(Jul 1975).

A system synthesis technique was employed for selecting the best outfall configuration for a stream that receives multiple thermal and organic waste discharges. The optimal locations for the cooling water and organic waste discharges, the optimal allocations of the wastes to these discharge points, and the optimal artificial aeration control policies were simultaneously determined. A dual water quality constraint on the minimum DO concentration and the maximum BOD concentration was imposed in order to ensure that the water quality be maintained above a minimum legal requirement. The complex pattern search method along with the modified algorithm of the maximum principle was used to generate the required information. A specific example of double-outfall system was solved to illustrate the theoretical development. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 20203, 20420, 22481, 22517, and 22677.

General Detectors and Monitors

Refer also to abstracts 19674, 20554, 20579, 21547, 21835, 22091, 22276, 22509, and 22552.

20243 (ANL-75-60(Pt.2), pp 137-145) RADON MONITOR FOR THE VAULT. May, H. A.; Miranda, J. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

A monitor for continuous recording of radon daughter concentration in the underground vault is described. The fraction of daughters attached to aerosol particles are collected on a fixed filter paper which is viewed by a ZnS(Ag) scintillator and photomultiplier tube. Results are displayed (as counts per minute) on a three decade logarithmic count rate meter. The observed count rate is much lower than would be predicted from known radon levels. Possible reasons for the low efficiency are discussed. (auth)

20244 (EGG-1183-2332) NUCLEAR RADIATION MEASUREMENT USING CHERENKOV LIGHT GENERATED IN A LIGHT GUIDE. Doyle, J. E.; Nelson, M. A.; Davies, T. J.; Franks, L. A. (EG and G, Inc., Santa Barbara, Calif. (USA)). Nov 1975. 6p. (CONF-751116-26). Dep. NTIS $3.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

Cherenkov light pulses were generated in one end of 100-m lengths of multi-fiber cable and a single strand of graded index fibers by a 50-ps burst of 18-MeV electrons. Pulse dispersion in this length was between 3.5 and 2.9 ns for the cabled fibers and 4.1 ns in the single fiber. By narrow band optical filtering, the dispersion was reduced to values between 610 and 246 ps in the cable and 400 ps for the single fiber. Cherenkov sensitivity was measured for two of the fibers and found to be 6×10^{13} photons/sec and 6×10^{12} photons/sec for 50 ps electron bursts of 10 A/cm^2 and 6 A/cm^2 respectively. In terms of time response and sensitivity it appears feasible to design a nuclear explosive diagnostic system utilizing Cherenkov radiation generated in and transmitted by cables of graded index fibers. (auth)

20245 (EUR-5370e, pp 25-28) POSITION ENCODER. Goursky, V. (CEN de Saclay, Gif-sur-Yvette, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Circuitry for deriving the quotient of signals delivered by position-sensitive detectors is described. Digital output is obtained in the form of 10 to 12 bit words. Impace position may be determined with 0.25% accuracy when the dynamic range of the energy signal is less than 1 : 10, and 0.5% accuracy when the dynamic range is 1 : 20. The division requires an average time of 5μs for 10-bit words. (auth)

20246 (EUR-5370e, pp 29-31) FAST ELECTRONICS FOR A METASTABLE SUPERCONDUCTING DETECTOR. Chase, R. L. (Brookhaven National Lab., Upton, NY); Gruhn, C.; Hrisoho, A.; Valette, C.; Waysand, G. Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A room temperature electronic device for the utilization of superheated superconducting granules as particle detectors is described. (auth)

20247 (EUR-5370e, pp 33-45) LOW NOISE CURRENT PREAMPLIFIERS FOR LARGE CAPACITANCE SEMICONDUCTOR DETECTORS AND HIGH COUNTING RATES. Gatti, E. (Politecnico, Milan); Manfredi, P. F. Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The current preamplifiers described are intended for applications with silicon detectors in high energy experiments. The basic circuit presents in parallel to the detector capacitance a dominant resistive component (cold resistance) which is stabilized by an internal feedback loop. Its noise performances have been optimized after a careful analysis which shows how a single unit, or iterated configurations of two or more units have to be used according to the values of the shaping time constants of the filter which follows the preamplifier. (auth)

20248 (EUR-5370e, pp 99-105) HYBRID, BROADBAND, LOW NOISE CHARGE PREAMPLIFIER FOR SIMULTANEOUS HIGH RESOLUTION ENERGY AND TIME INFORMATION WITH LARGE CAPACITANCE SEMICONDUCTOR DETECTOR. Goyot, M. (Univ., Lyon). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A broadband and low noise charge preamplifier was developed in hybrid form, for a recoil spectrometer requiring large capacitance semiconductor detectors. This new hybrid and low cost preamplifier permits good timing information without compromising energy resolution. With a 500 pF external input capacity, it provides two simultaneous outputs: (i) the faster, current sensitive, with a rise time of 9 nsec and 2 mV/MeV on 50 Ω load, (ii) the lower, charge sensitive, with an energy resolution of 14 keV (FWHM Si) using a RC-CR ungated filter of 2 μsec and a FET input protection. (auth)

20249 (EUR-5370e, pp 113-116) THEORETICAL INVESTIGATION OF THE RISE-TIME READOUT METHOD FROM POSITION SENSITIVE DETECTORS EMPLOYING RESISTIVE ELECTRODES. Arbel, A. F. (Technion-Israel Inst. of Tech., Haifa). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Position information is obtainable with position-sensitive detectors employing resistive electrodes by the basically dissimilar "rise-time readout" and "charge-division" methods. The first of these methods is discussed. Computer analysis has been employed to investigate the performance of various filters with respect to position information and linearity, for the unterminated case. The filter time-constants can be chosen to optimize either linearity, or resolution. In the latter case, a non-linear data display can be used in order to linearize the position information, so that optimal resolution and linearity can be achieved simultaneously. (auth)

20250 (EUR-5370e, pp 117-122) NEW DEVELOPMENTS FOR POSITION SENSITIVE SEMICONDUCTOR DETECTORS. Gruhn, C. R. (CERN, Geneva). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A general discussion is given on sensitivity considerations in position measurements using semiconductor devices having internal amplification. Both current division and multielectrode devices are considered. Two mechanisms for achieving internal amplification (avalanche and transistor) are discussed. Data are presented which show that considerable improvement in signal to noise can be achieved using the transistor gain mechanism. (auth)

20251 (EUR-5370e, pp 123-128) POSITION SENSITIVE SCINTILLATION DETECTOR FOR NEUTRONS. Grosshog, G. (Chalmers Univ. of Tech., Goteborg). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The space distribution of neutron interactions in a Li-glass scintillator can be measured with a method which uses the relative pulse amplitudes from two photomultipliers as position indicators. A computerized measuring system for such a detector is described. The resolution of the detector and the electronic system has a FWHM-value of 5.4 ± 0.4 per cent. (auth)

20252 (EUR-5370e, pp 135-138) FAST TWO-DIMENSIONAL READOUT FOR PROPORTIONAL MULTIDETECTOR. Chardonnet, B.; Jacobe, J. (Institut Laue-Langevin, Grenoble, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A new speed reading system has been developed for use with large multielectrode gas detectors (Multidetectors). These detectors detect and sense the position of thermal neutrons in one or two dimensions. This system is synchronous and uses the multiple information induced on the electrodes by a simple neutron. The dead time for each neutron detected is less than 1 μsec and the probability of address error is very low. (auth)

20253 (EUR-5370e, pp 139-143) TWO-DIMENSIONAL MWPC READOUT AT 10 MHz. Parkman, C.; Hajduk, Z.; Jeavons, A.; Ford, N.; Lindberg, B. (CERN, Geneva). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Two-dimensional readout of a proportional chamber is presented, using hardware digital techniques: priority encoders and hardware processing. An event rate of 10 MHz and spatial

resolution of 0.5 mm is obtained. Applications to dynamic X-ray studies using synchrotron radiation are foreseen. (auth)

20254 (EUR-5370e, pp 151-152) FAST CAMAC MEAN VALUE DIGITIZER FOR CHARPAK PROPORTIONAL CHAMBER. Demiere, C.; Vuilleumier, G. (Univ., Geneva). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A drift proportional chamber with a fast CAMAC data processing system, a small computer, and a plasma display to reproduce the measured picture is described for x-ray detection. (WHK)

20255 (EUR-5370e, pp 179-181) GAIN STABILIZATION FOR RADIATION DETECTORS USING PHOTOMULTIPLIERS. Chalupka, A.; Kratschmar, H.; Tagesen, S. (Institut fuer Radiumforschung und Kernphysik, Vienna). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
Gain stabilisation is accomplished in two ways: (a) dynode voltages stable to 100 ppm for full load change are achieved by means of an active voltage divider circuit, and (b) long term gain drifts are compensated for by an over all gain regulation system with respect to a standard light pulse (stability 1%). (auth)

20256 (EUR-5370e, pp 183-185) INDUSTRIAL DEFECTOSCOPE BASED ON MULTIWIRE PROPORTIONAL CHAMBER IN CAMAC SYSTEM. Brzeski, P.; Kazubek, M.; Mirkowski, J.; Szabatin, R. (Technical Univ., Warsaw). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
An industrial defectoscope based on two types of multiwire proportional chamber (MWPC) is presented. Information on chamber construction, electronics attached directly to the chamber, and the CAMAC logic are discussed. Some software problems for data collected from the chamber processing are also mentioned. (auth)

20257 (EUR-5370e, pp 187-193) CURRENT TRENDS IN NUCLEAR MEDICINE. Guzzardi, R.; Donato, L. (CNR, Pisa, Italy). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
Recent advances in instrumentation and equipment for scintigraphy are reviewed. Photon transmission scanning, x-ray fluorescence scanning, and positron emission techniques are discussed. (WHK)

20258 (EUR-5370e, pp 195-198) RUGGED NUCLEAR RADIATION DETECTOR FOR MEDICAL AND BIOLOGICAL APPLICATIONS. Allsworth, F. L.; Awcock, M. L.; Howes, J. H. (Atomic Energy Research Establishment, Harwell, Eng.). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
Rugged silicon radiation detector probes sensitive to β particles and low energy X and γ rays, principally for use in medical and biological applications are described. The energy threshold for X-ray detection at 20°C is 14 keV and at blood temperature (37°C) the detection threshold is 24 keV. The detectors are fabricated using thermal diffusion to produce the p-n junction resulting in a robust diode structure. The method of protecting the junction is described together with the detector encapsulation technique. The preamplifier is designed as an integral part of the detector assembly and forms the probe handle in medical and biological applications. The amplifier probe is used in conjunction with the Harwell "6000" series electronic system. (auth)

20259 (EUR-5370e, pp 199-204) APPLICATION OF NUCLEAR INSTRUMENTATION TECHNIQUES TO X-RAY DIFFRACTION FROM MUSCLE. Faruqi, A. R. (Medical Research Council, Cambridge, Eng.). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
The applications of position sensitive counters and multichannel analyzers to X-ray diffraction data collection from live muscle undergoing contraction are described. Electronic data collection methods are described which enable time resolved studies of the X-ray patterns. It is expected that such information will lead to a clearer understanding of the structural changes, at a molecular level, taking place during muscular contraction. (auth)

20260 (EUR-5370e, pp 205-210) FOUR-CHANNEL STORAGE TELEMETRICAL MEASURING SYSTEM FOR MONITORING RADIONUCLIDE-TRACERS IN VIVO. Bojsen, J.; Vadstrup, S. (Finsen Inst., Copenhagen). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
This report deals with the problems of long term biotelemetry of radionuclide-tracers in general, both in animal and man. Several measuring techniques have been developed. A storage telemetrical, battery operated, measuring device for detection of radionuclide-tracers in humans is described. The weight is 600 g. A pocket-sized ECG cassette tape recorder with 24-h continuous registration constitutes the storage unit. End-window GM-tubes are used as surface detectors. Alternative radionuclide detector types are discussed. (auth)

20261 (EUR-5370e, pp 225-228) NOVEL γ CAMERAS. Shafrir, B.; Seidman, A.; Avrahami, Z. (Tel Aviv Univ., Israel). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
The γ-ray cameras described are based on radiation imaging devices which permit the direct recording of the distribution of radioactive material from a radiating source, such as a human organ. They consist of a collimator, a converter matrix converting γ photons to electrons, and an electron image multiplier producing a multiplied electron output, and means for reading out the information. The electron image multiplier is a device which produces a multiplied electron image. It can be either a gas avalanche electron multiplier or a multi-channel plate. The three described embodiments, in which the converter matrix can be either of metal type or of scintillation crystal type, were designed and are being developed. (auth)

20262 (EUR-5370e, pp 361-364) REMOTE CONTROLLED TRIGGER LOGIC ASSOCIATED WITH SCINTILLATION COUNTERS. Besset, D.; Hess, R.; Rapin, D. (Univ., Geneva). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
Automatic remote control of a set of delay lines, coincidence units, high voltage supplies, and counting scalers is possible with the CAMAC system. A computer-supervised variable trigger logic for particle physics experiments at the CERN synchrocyclotron is described. (WHK)

20263 (EUR-5370e, pp 365-367) READOUT UNIT FOR DRIFT CHAMBERS. Turala, M. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A readout unit for drift chambers has been built in a single CAMAC module. It is able to measure up to 4 coordinates from 16 wires with an intrinsic accuracy of about 1% of range. (auth)

20264 (EUR-5370e, pp 447-451) VERSATILE PULSE SHAPE DISCRIMINATOR FOR CHARGED PARTICLE SEPARATION. White, G. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A pulse shape discriminator is described whose operating principle is based on the comparison of two weighted time integrals of the detector signal. When used in the detection of neutrons useful separation from γ rays can be obtained from about 50 keV neutron energy, with a dynamic range greater than 400. (auth)

20265 (EUR-5370e, pp 453-456) STUDY OF THE OPERATION AND PERFORMANCES OF AN AVALANCHE DIODE AS A SINGLE-PHOTON DETECTOR. Antognetti, P. (Univ., Genoa); Cova, S.; Longoni, A. Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
Small area, uniform avalanche breakdown p-n junction diodes operating a few volts above breakdown can be used as single-photon detectors. Simple bias circuits are normally employed, where the avalanche, triggered by single carriers, is quenched by the voltage drop on a load resistor. Limitations due to these circuits have been studied. An external-quenching scheme has been devised and tested. In such a scheme, the operation of the diode is similar to the one of a non-paralyzable monostable, with a well-definite deadtime, having a short duration. Results obtained and possible developments are discussed. (auth)

20266 (LYCEN-7534) HYBRID, BROADBAND, LOW NOISE CHARGE PREAMPLIFIER FOR SIMULTANEOUS HIGH RESOLUTION ENERGY AND TIME INFORMATION WITH LARGE CAPACITANCE SEMICONDUCTOR DETECTOR. Goyot, M. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire). May 1975. 7p. Dep. NTIS (US Sales Only) $3.50.
A broadband and low noise charge preamplifier was developed in hybrid form, for a recoil spectrometer requiring large capacitance semiconductor detectors. This new hybrid and low cost preamplifier permits good timing information without compromising energy resolution. With a 500 pF external input capacity, it provides two simultaneous outputs: (i) the faster, current sen-

sitive, with a rise time of 9 nsec and 2 mV/MeV on 50 Ω load, (ii) the lower, charge sensitive, with an energy resolution of 14 keV(FWHM Si) using a RC-CR ungated filter of 2 μsec and a FET input protection. (auth)

20267 PORTABLE APPARATUS FOR MEASUREMENT OF NUCLEAR RADIATION. Whitlock, G. D. British Patent 1,403,265/B/. 20 Aug 1975. Filed Date 6 Oct 1972. 5p.

The apparatus described is stated to be particularly applicable to the measurement of tritium contamination of a surface, although it may have other applications to the determination of radioactivity on surfaces. The mean range of a tritium β particle in air at normal atmospheric pressure is only 1.5 mm. and when monitoring such radiation with the apparatus it is necessary to exclude light. The apparatus comprises a plastic scintillator sheet located in the base of a housing, with a sealing ring mounted in the base so as to make a hermetic and light-tight seal between a support surface and the base of the housing. Photomultiplier means are optically coupled to the scintillator sheet to detect and amplify the scintillations, and a pump device is provided to reduce the air pressure in the vicinity of the sheet to below atmospheric pressure. The scintillator sheet and the photomultiplier means are movable as one unit within the housing, the unit being arranged to be acted upon by atmospheric pressure so as to move the unit into an operative position against a spring when the air pressure in the vicinity of the sheet is reduced to below atmospheric pressure. A shutter is provided to prevent exposure of the scintillator sheet to light when the apparatus is not in use. (UK)

20268 AREAL DETECTION EFFICIENCY OF CHANNEL ELECTRON MULTIPLIER ARRAYS. Panitz, J.A.; Foesch, J.A. (Sandia Laboratories, Albuquerque, New Mexico 87115). Rev. Sci. Instrum. 47: No. 1, 44-49 (Jan 1976).

The areal detection efficiency of a channel electron multiplier array (CEMA) and the nature of its secondary emission surface were investigated with the ion microprobe mass analyzer (IMMA). Previous speculations of detection efficiency based on simple geometric arguments of channel-to-interchannel area ratios are shown to be in error. With a positive bias applied to a front electrode surface of high secondary yield, areal detection efficiency of a CEMA may approach 100% even for single-ion impacts. The secondary emission properties of a CEMA are shown to be determined by an alkali-rich surface layer on each channel wall, and not a concentration of Pb or PbO as previously thought. Both reversible and irreversible gain degradation observed when heating a CEMA in vacuum are interpreted as a change in the composition of this layer. (auth)

20269 CHANNELTRON ENTRANCE APERTURE GAIN VARIATIONS FOR ENERGETIC HEAVY IONS. Hird, B.; Suk, H.C.; Guilbaud, A. (Department of Physics, University of Ottawa, Ottawa K1N 9B4, Canada). Rev. Sci. Instrum. 47: No. 1, 138-142 (Jan 1976).

Considerable differences in the current gain have been found in a channel electron multiplier when used as a detector of 100 keV N_i^+ ions, depending on the point of impact at the channel entrance. These differences occur at high current gains which are usually considered near to saturation. In contrast to the current gain, the detection efficiency shows no significant variation with the point of impact, suggesting that at least one of the electrons from the primary interaction of the ion with the secondary surface is multiplied by the channel to provide a detectable pulse. (auth)

20270 INEXPENSIVE LABORATORY X-RAY TOMOGRAPHIC SCANNER. Elings, V. B. (Univ. of California, Santa Barbara); Jensen, E. G.; Sherburne, J. S. IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2685-2688(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A computerized transverse-axial x-ray scanning tomography system has been constructed and operated using inexpensive and readily available components. The system is used only for the scanning of phantoms and the image reconstruction is carried out on an IBM 360/75. Images reconstructed from data taken by the device are able to resolve radiographic density variations of about ½ percent over distances of 0.5 cm. (auth)

20271 GAMMA-RAY ENERGY DEPOSITION IN SILICON DETECTORS. Lurie, N. A.; Steiman, D. K.; Harris, L. Jr.; Wondra, J. P. (IRT Corporation, San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2582-2594(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Calculations of the gamma-ray energy deposition spectrum have been performed for a silicon ionization dosimeter based on a silicon surface barrier detector. The technique used was a coupled photon-electron transport calculation using the three-dimensional Monte Carlo code, SANDYL. Comparison of calculated pulse-height spectra and measurements of standard calibrated gamma sources demonstrated the need to take into account the nonuniformity of the charge collection efficiency in the device. To this end, measurements were made of the radial dependence of the charge collection efficiency and sensitive volume. These results yielded an improved model and improved agreement between calculation and experiment. (auth)

20272 STATUS AND PROSPECTS FOR CdTe DETECTOR APPLICATIONS. Entine, G. (Radiation Monitoring Devices, Inc., Newton, MA). Trans. Am. Nucl. Soc.; 22: 123-124(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20273 249-cm^3 Ge(Li) DETECTOR FOR MEDICAL IMAGING. Kirby, J. A. (Univ. of California, Livermore); Phelps, P. L.; Sawyer, D.; Armantrout, G. A.; Shipley, W. W.; Atkins, F. B.; Charleston, D. B.; Neck, R. N. Trans. Am. Nucl. Soc.; 22: 125-126(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20274 DYNAMIC BEHAVIOR OF RADON DIFFUSION CHAMBERS. Culot, M. V. J. (INEN, Mexico City); Sanchez, J.; Olson, H. G. Trans. Am. Nucl. Soc.; 22: 129-130(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20275 DESIGN AND OPTIMIZATION OF FISSION COUNTERS FOR OPERATION AT HIGH γ DOSE RATES. Pare, V. K. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 131(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20276 TRANSVERSE DISCHARGE LASER WITH NUCLEAR PRE-IONIZATION. Miller, T. G. (Army Missile Command, Redstone Arsenal, AL); Morrison, G. W.; Gibson, F. P. Trans. Am. Nucl. Soc.; 22: 134-135(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20277 MONTE CARLO COMPUTER MODEL TO OPTIMIZE LIGHT YIELD FROM LiF-ZnS SCINTILLATORS. Bossi, R. H.; Robinson, A. H. (Oregon State Univ., Corvallis). Trans. Am. Nucl. Soc.; 22: 153(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20278 MULTICRYSTAL CHAIR COUNTER FOR NUCLEAR PLANT USE. Hearn, R. A.; Walker, D. M.; Tuten, T. U. (Applied Physical Tech., Atlanta). Trans. Am. Nucl. Soc.; 22: 155-156(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20279 DIGITAL INVERSE RESPONSE FUNCTION ANALYSIS OF SELF-POWERED NEUTRON DETECTOR SIGNALS. Carpenter, J. M.; Fleming, R. F.; Bozorgmanesh, H. (Univ. of Michigan, Ann Arbor). Trans. Am. Nucl. Soc.; 22: 606-607(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20280 DETECTOR RESPONSE CORRECTION IN INVERSE MULTIPLICATION TECHNIQUE. Lee, J. C.; Van Tuyle, G. J. (Univ. of Michigan, Ann Arbor). Trans. Am. Nucl. Soc.; 22: 607-608(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20281 MONITOR FOR TRITIUM IN AIR CONTAINING OTHER β EMITTERS. Jalbert, R. A. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 739-740(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20282 APPLICATION OF TLD AS A REACTOR FLUX DETERMINANT. Schwenk, R. M. (Ballistics Research Lab., Aberdeen Proving Ground, MD); McKlveen, J. W. Trans. Am. Nucl. Soc.; 22: 802-803(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20283 EFFICIENCY OF MEASUREMENT WITH THE COMPUTER 2154-1-M "PROTOKA" IN DEPENDENCE ON THE MEAN ENERGY OF β-RADIATION AND THE PLACING OF THE SAMPLES. Jandl, J. Chem. Listy; 69: No. 11, 1197-1201(1975). (In Czech).

The efficiencies of the detection of radiations with a β-proportional flow-counter of the 2154-1-1M "PROTOKA" type were determined. The flow-counter operates in the 4π geometry while using an aluminium foil of area mass 2 mg/cm² as a base. The effect of an asymmetric placing of the sample on the support, with respect to the anodes, on the recorder frequency of the impulses was also studied. (auth)

Radiation Dosimeters

Refer also to abstract 21821.

20284 (CONF-760301-1) INTERCOMPARISON OF PERSONNEL DOSIMETERS. Dickson, H. W.; Fox, W. F.; Haywood, F. F. (Oak Ridge National Lab., Tenn. (USA)). 1974. 8p. Dep. NTIS $3.50.

From NBS symposium on measurements for the safe use of radiation; Gaithersburg, Maryland, United States of America (USA) (1 Mar 1976).

An intercomparison of personnel monitoring dosimeters was conducted at Oak Ridge National Laboratory's DOSAR Facility. Ten independent laboratories and companies participated in an intercomparison of neutron and gamma-ray dosimeters used for routine personnel dosimetry. The dosimeters, which were sent through the mail, were exposed at the Health Physics Research Reactor to the same three "standardized" radiation fields which have been used for the past several years for intercomparing nuclear accident dosimeters. In addition, a 14-MeV neutron field was used as a fourth exposure condition. The results of the intercomparison show widely varying dose estimates. The reported values of neutron dose equivalent, for example, have standard deviations ranging from 47 to 102 percent of the mean. (auth)

20285 NEW "WALL-LESS" IONIZATION CHAMBER FOR AIR DOSE MEASUREMENT. Varma, M.N.; Baum, J.W. (Health Physics and Safety Division, Brookhaven National Laboratory, Upton, New York 11973). Rev. Sci. Instrum. 47: No. 1, 112-114 (Jan 1976).

A simple mesh wall ionization chamber (representing a "wall-less" ionization chamber) is described for air dose measurement. The effects of insulators and air circulation in the vicinity of the chamber were studied. An outer shield mesh placed around the collecting chamber eliminates the adverse effects of air circulation and electrostatic disturbances around the detector. The detector can be used effectively to measure that component of dose due to low energy electrons or x rays which are normally stopped by the walls of conventional dose measuring instruments. The mesh ion chamber is particularly useful in measuring dose distribution in and around a radiation field. This chamber approximates a free air ion chamber that can be used at low, as well as high, energies once electron equilibrium is achieved. The chamber was tested using ^{137}Cs gamma radiations and gives good agreement with a model 570 Victoreen R meter. (auth)

20286 SILICON CALORIMETER SYSTEM FOR GAMMA AND ELECTRON-BEAM RADIATION DOSIMETRY. Wrobel, T. F.; Berger, R. A. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2314-2318(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A dosimetry system was designed and constructed based on silicon calorimeters. Both silicon thermocouple and thermistor calorimeters, used in the study of I/sub pp/ measurements of silicon transistors, are described. The system provided active total-dose measurements at six radiation facilities: a Linac and five FXR pulsers. The system gave accurate and consistent results with a minimum of complications. (auth)

20287 DOSIMETRY OF GAMMA-IRRADIATED SEMICONDUCTOR DEVICES. Barry, A. L. (Communications Research Center, Ottawa). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2703 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Extensive use is made of ^{60}Co gamma radiation for the investigation of radiation effects in semiconductor devices. A survey of the literature, however, reveals widespread inconsistencies and loose usage in the units of dosimetry. This note points out that rigorous definitions of the concepts "absorbed dose" and "exposure," and their units, have been established by the International Commission on Radiation Units and Measurements (ICRU), and suggests greater consistency by workers in the field of radiation effects in electronic devices and materials. (auth)

20288 X-RAY FLUORESCENCE MEASUREMENT OF SILVER FOR EXPOSURE OF ENVIRONMENTAL MONITORING FILM. Duffey, D. (Univ. of Maryland, College Park); Beck, W. L.; Gleason, G. I.; Wiggins, P. F. Trans. Am. Nucl. Soc.; 22: 98-99(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20289 PROPORTIONAL COUNTER FOR CHARGED-PARTICLE ENERGY DEPOSITION DISTRIBUTION MEASUREMENTS. Berthoud, G. (CEN, Grenoble, France); Bull, S. R.; Giroux, J.; Herbaut, Y.; Smith, L. A. Trans. Am. Nucl. Soc.; 22: 129(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 19660, 20423, and 21556.

20290 (BP-1393) AUTOMATED MULTISPECTRA ALPHA SPECTROMETER AND DATA REDUCTION SYSTEM. Hochel, R. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Dec 1975. Contract AT(07-2)-1. 16p. Dep. NTIS $4.50.

A complete hardware and software package for the accumulation and rapid analysis of multiple alpha pulse height spectra has been developed. The system utilizes a 4096-channel analyzer capable of accepting up to sixteen inputs from solid-state surface barrier detectors via mixer-router modules. The analyzer is interfaced to a desk-top programmable calculator and thermal line printer. A chained software package including spectrum printout, peak analysis, plutonium-238 and plutonium-239 data reduction, and automatic energy calibration routines was written. With the chained program a complete printout, peak analysis, and plutonium data reduction of a 512-channel alpha spectrum are obtained in about three minutes with an accuracy within five percent of hand analyses. (auth)

20291 (EUR-5370e, pp 9-19) TRANSVERSAL FILTERS FOR PULSE SPECTROSCOPY. Miller, G. L.; Robinson, D. A. H. (Bell Labs., Murray Hill, NJ). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Transversal filtering consists of forming an output signal from the suitably weighted sum of successively delayed samples of a given input waveform. Although such filters exhibit many attractive features, economic considerations have previously limited their hardware implementation to rather few areas, primarily the fields of communications and radar. However, recent technological developments have significantly reduced the cost of the multiple tapped-delay operations that are required in such filters, thereby greatly expanding their potential areas of application. The purpose of the present paper is twofold, first to serve as a general introduction to the possibilities of transversal filters for the processing of isolated randomly distributed pulses (such as occur in experimental nuclear physics), and second to introduce a new implementation of such filters in the form of capacitively tapped delay lines. This latter form of transversal filter is readily fabricated and is well suited for operation on pulses in the few nanosecond to few microsecond time range. (auth)

20292 (EUR-5370e, pp 21-24) PHOTODIODES VERSUS PHOTOMULTIPLIERS FOR SPECTROMETRY. Roberts, P. B. (National Radiological Protection Board, Harwell, Eng.). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Three factors to consider when choosing between a photomultiplier and photodiode are studied, including the signal-to-noise ratio, changes due to event rate, and transit time. Where light intensities are such that photocathode currents are below about 10^{-9} amperes the photomultiplier has the better S/N characteristics. In the nuclear field, therefore, in applications where low light levels and high resolution is of prime importance, the use of a photodiode-amplifier combination would not be advantageous. However, experiments indicate that some advantages may be gained in reducing the number of dynodes in a conventional photomultiplier and using external amplifiers to compensate for the consequent loss in gain. These advantages may be summarized as follows: lower EHT power supplies, components are used in a closed loop system and hence instability is reduced, greater ease of control of overall gain, and a reduction of transit time. (WHK)

20293 (EUR-5370e, pp 47-65) ACCURATE MEASUREMENT OF NOISE PARAMETERS IN ULTRA-LOW NOISE OPTO-FEEDBACK SPECTROMETER SYSTEMS. Llacer, J. (Univ. of California, Berkeley). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The accurate measurement of the basic noise parameters of ultra-low noise spectrometer systems has been developed in the frequency domain by spectrum analysis. This method overcomes some of the difficulties experienced in using conventional techniques. An analytic and experimental comparison between "time" and frequency domain techniques is carried out and the use of the latter as a method to develop extremely low-noise detector and FET packages is demonstrated. The origin of the remaining noise in high quality systems is traced to surface and gate junction generation through traps in the FET. (auth)

20294 (EUR-5370e, pp 87-92) IMPROVEMENT OF SIGNAL/NOISE-RATIO IN ANALOG PULSE HEIGHT ANALYSIS FOR SPACECRAFT APPLICATION. Nowack, G.; Klein, J. W. (Ruhr-Univ., Bochum, Ger.). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Besides the normal requirements of pulse height analysis the typical demands for spacecraft application must be fulfilled. Main effort of work is given to a standardized calculation system for the design of optimum pulse shaping with linear, time invariant filters for different noise power density spectra regarding also the shape of the primary detector current pulse as well as preamplifier-shaping. Due to their simple structure and the relatively small sensitivity to parameter tolerances RC-optimum-filters are considered. To decide whether different time constants for differentiator and integrator result in an inhancement of the signal/noise-ratio as indicated for an RC-filter by TSUKUDA, extensive numerical computation was undertaken. The results show that the maximum signal/noise-ratio requires identical time constants. (auth)

20295 (EUR-5370e, pp 93-94) PRECISION THRESHOLD DISCRIMINATOR. Bayer, R. (Inst. of Nuclear Research, Swierk, Poland). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Precision threshold discriminator has been built for the signals from about 0.5 mV up. It's dynamic range is up to 10^4 and linearity $6 \cdot 10^{-5}$ or even better. The discriminator can discriminate both negative and positive d.c. voltages and pulses of width from 100 ns. (auth)

20296 (EUR-5370e, pp 153-160) PULSE PROCESSOR FOR X-RAY SPECTROMETRY WITH Si(Li)-DETECTORS. Kandiah, K.; Smith, A. J.; White, G. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

This paper describes the general features of a pulse processor for use with opto-electronic charge sensitive head amplifiers particularly with Si(Li) X-ray detectors. The instrument contains time-variant filters with direct coupled amplifiers and comprehensive pile-up protection and live time correction. The test results indicate that the system can cope with an extremely wide range of signal processing times, counting rates and changes of spectral content without any appreciable degradation in energy resolution and with useful output rates for input rates up to well over 50,000 events/sec. (auth)

20297 (EUR-5370e, pp 161-165) MWPC AMPLIFIER AND READOUT SYSTEM. Loude, J. F. (Univ., Lausanne, Switzerland); Morel, N.; Winkelmann, E.; Alder, J. C.; Joseph, C.; Vaucher, B.; Schmitt, H. Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A 9000 wire proportional chamber system is being built for a γ magnetic pair spectrometer. Simple and small preamplifiers are mounted on the chambers; flat cables a few meters long link them with the main electronics; the readout logic looks for the clusters of hit wires, encodes the size and the position of each one and transfers these coded data, via CAMAC, to the computer. (auth)

20298 (EUR-5370e, pp 169-171) NEW GENERATION OF INDIVIDUAL SAFEGUARD SYSTEMS. Cornet, A.; Regal, R.; Ponpon, J. P.; Siffert, P. (Centre de Recherches Nucleaires, Strasbourg). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

By taking advantage of the progress of new semiconductor γ-ray counters working at room temperature, a compact and sensitive individual safeguard system using CdTe and HgI_2 sensors was developed. Details of the electronics are presented. Two methods of overcoming the time dependent polarization effect are presented. (auth)

20299 (EUR-5370e, pp 173-177) ANALOG SIGNAL PROCESSOR FOR COMPTON SUPPRESSION. Shoffner, B. M. (Harshaw Chemical Co., Solon, OH). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

γ ray spectrometers for low level radionuclide analysis using a Ge(Li) detector can often benefit from the use of a surrounding NaI(Tl) scintillation guard detector or annulus. Through the use of appropriate electronics, energy degraded signals from the prime Ge(Li) detector due to Compton scattered events can be rejected and the system detectability improved. Conversely, isotope identification can often be facilitated through measurement of coincidently emitted γ rays. The design and performance of a NIM module which contains all of the circuitry required to perform simultaneous coincidence/anti-coincidence time analysis on signals coming directly from the guard detector phototubes and the Ge(Li) preamp are discussed. (auth)

20300 (EUR-5370e, pp 273-277) γ SCANNING EQUIPMENT FOR NUCLEAR SAFEGUARDS. De Grandi, G.; Stanchi, L. (EURATOM, Ispra, Italy). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Many reasons justify the use of γ techniques in the field of nuclear safeguards. This paper describes electronic equipment for γ-scanning of non-irradiated fuel elements. The control of the operation is completely digital and driven by a minicomputer and gives more accurate results in respect of an analog chain which has been successfully used in fuel element manufacturing plants. (auth)

20301 (EUR-5370e, pp 295-301) MINICOMPUTER ALGORITHM FOR FITTING A GAUSSIAN CURVE TO γ-RAY SPECTRUM PEAKS. Deighton, M. O. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A direct method, based on algebraic analysis, is presented for fitting a Gaussian curve to a set of channel/count output data from a γ-spectrometer. The method is a least-squares optimization and allows for varying statistical weights of the data. It is useful where no appreciable systematic deviations from Gaussian shape occur, i.e. mainly with singlet γ (or x-ray) peaks from high-quality analysers, but backgrounds can be accommodated, provided they can be estimated and subtracted first. As no repetitive approximation routines are involved and there are only three basic parameters (peak position, height, and width) to determine, the computing requirements are well within the capacity of a minicomputer; in simpler cases a pocket calculator is sufficient. Typical accuracy of results, and other points, are discussed in the context of two numerical examples. (auth)

20302 (EUR-5370e, pp 381-383) CAMAC COMPUTERIZED SYSTEM FOR NUCLEAR SPECTROMETRY. Bieche, J. L.; Boute, G.; Servent, J. M. (Schlumberger, Bagneux, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The use of a CAMAC standard module system for data acquisition and processing for a Ge(Li) γ spectrometer using a PDP 11/05 computer is briefly described. (WHK)

20303 (EUR-5370e, pp 421-428) FAST MULTI-EVENT TIME DIGITIZER IN A CAMAC MODULE. Argyle, J. P.; Dolley, P. E.; Huxtable, G. (Atomic Energy Research Establishment, Harwell, Eng.). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Harwell has recently developed a time-digitizer in the CAMAC format, designed primarily for neutron time-of-flight measurements, though other applications are likely. This new digitizer is compatible with the burst width (5 nsec) and high instantaneous pulse rates of the Harwell Synchro-cyclotron. The new unit, a 5-width module, measures the times between a start pulse and a succession of event pulses in binary digital form. The digitized time is held in an 18 word buffer store, from which it can be read out onto the CAMAC dataway. The basic time reference is a 100 MHz free-running crystal clock. The resulting 10 nsec time channels would be too wide for the required resolution, so an interpolation system has been incorporated. This measures and records the interval between each event pulse (or start pulse) and the succeeding clock, using a tapped delay line. The taps are spaced at 1.25 nsec intervals, which determines the overall resolution of the system. The least significant bits of the time difference between start and event are obtained by immediately subtracting the corresponding interpolator values by hardware before the digitised time goes to the buffer store. (auth)

20304 (EUR-5370e, pp 457-458) INFORMATION CODING AND ACQUISITION IN THE TIME-OF-FLIGHT SPECTROMETER USING THE DIGITAL COMPUTER. Zhook, V. I.; Markov, D. A.;

Tsitovitch, A. P.; Shitikov, B. I. (Inst. of Atomic Energy, Moscow). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A measuring system for the time-of-flight neutron investigations is considered. The system consists of a time-of-flight meter and a general purpose digital computer with the disc storage. The structure of the meter is described and its main parameters are given. The software for the event storing and sorting is described. Up to sixteen detectors can be serviced by the meter. The minimum channel width is 20 nsec, and the dead time is 2 μsec. The total number of the spectrum channels exceeds 10^6. The meter is made in accordance with the VECTOR standards. (auth)

20305 (UCRL-77151) CHARGED-PARTICLE MAGNETIC-QUADRUPOLE SPECTROMETER FOR NEUTRON INDUCED REACTIONS. Haight, R. C.; Grimes, S. M.; Tuckey, B. J.; Anderson, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1975. Contract W-7405-Eng-48. 28p. (CONF-751088-1). Dep. NTIS $4.00.

From APS meeting; Austin, Texas, United States of America (USA) (30 Oct 1975).

A spectrometer has been developed for measuring the charged particle production cross sections and spectra in neutron-induced reactions. The spectrometer consists of a magnetic quadrupole doublet which focuses the charged particles onto a silicon surface barrier detector telescope which is 2 meters or more from the irradiated sample. Collimators, shielding, and the large source-to-detector distance reduce the background enough to use the spectrometer with a 14-MeV neutron source producing 4 . 10^{12} n/s. The spectrometer has been used in investigations of proton, deuteron, and alpha particle production by 14-MeV neutrons incident on various materials. Protons with energies as low as 1.1 MeV have been measured. The good resolution of the detectors has also made possible an improved measurement of the neutron-neutron scattering length from the 0^0 proton spectrum from deuteron breakup by 14-MeV neutrons. (auth)

20306 DELAYED COINCIDENCE METHODS. Loebner, K. E. G. (Technische Univ., Munich). pp 173-236 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

The principles of the most important delayed coincidence methods that are used to measure the half-lives of excited states are presented. Those methods which are believed will be of more importance in the future receive the most full discussion. In particular the timing performance of Ge(Li) detectors is described in more detail than timing with other counters. (auth)

20307 DOPPLER SHIFT TIMING METHODS. Allen, K. W. (Nuclear Physics Lab., Oxford). pp 311-339 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

In nuclear reactions, the slowing down of the residual nuclei in the target backing depends on the nature of the stopping medium, and provides a time scale (through the Doppler effect) with which the decay of nuclear excited states can be compared. It can also be arranged that an excited nucleus recoils freely in vacuum so that the emitted gamma rays exhibit the full Doppler effect. Timing methods utilizing these effects, specifically the Doppler shift attenuation method and the distance recoil method, respectively, are detailed. (SDF)

20308 ROCKET-BORNE DOUBLE FOCUSING ANALYZER FOR PARTICLE SPECTROSCOPY IN THE LOWER MAGNETOSPHERE. Crifo, J.F.; Prange, R.; Cornic, C.; Salvetat, P. (Laboratoire de Physique Stellaire et Planetaire, B.P. 10, 91370 Verrieres le Buisson, France). Rev. Sci. Instrum. 47: No. 1, 6-14 (Jan 1976).

We describe a rocket-borne instrument for measurement of the low energy electron and proton distribution function in the magnetosphere. It consists of an optimized programmable electrostatic toroidal analyzer as an energy selector, coupled with an electron multiplier as a particle detector, and of the associated electronics. Much attention has been paid to the experimental calibration of the instrument which gives us some understanding of the real behavior of the detector and the way it influences the analyzer properties. (auth)

20309 FUTURE OF SEMICONDUCTOR γ-RAY SPECTROMETERS. Armantrout, G. A.; Yee, J. H.; Sherohman, J. W.; Swierkowski, S. P. (Univ. of California, Livermore). Trans. Am. Nucl. Soc.; 22: 123(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

High Energy Physics Instrumentation

20310 (CEA-CONF-3152) HIGH RESOLUTION MAGNETIC SPECTROMETRY. Beurtey, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 72p. (CONF-7506100-2). Dep. NTIS (US Sales Only) $4.50.

From proceedings of the advanced study institute in nuclear and particle physics at intermediate energies; Victoria, B. C., Canada (Jun 1975).

The high-resolution magnetic spectrometers SPES I and SPES II at Saturne are described in detail. The principles necessary to achieve a high resolution with magnetic spectrometers are described, and the future of high resolution spectrometry at Saturne is discussed. (WHK)

20311 (CONF-7509108-1) 15-FOOT BUBBLE CHAMBER CHARACTERISTICS. Huson, F. R. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). 15 Sep 1975. 66p. Dep. NTIS $5.50.

From Fermilab symposium on hadrons in bubble chambers; Batavia, Illinois, United States of America (USA) (18 Sep 1975).

Specifications, operation, characteristics, cost, and experience with the NAL 15-ft bubble chamber are described. Beam availability and some experimental proposals are discussed. (WHK)

20312 (EUR-5370e, pp 1-8) PARTICLE IDENTIFICATION BY PROCESSING OF SIGNALS FROM MULTIPLE DETECTORS. Gatti, E.; Radeka, V.; Rosenblum, M. (Brookhaven National Lab., Upton, NY). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

It is shown that for particle identification it is convenient to develop instrumentation based on coding the output of the detectors according to the ratio of probabilities that a particular signal is given by the two kinds of particles considered. Particular emphasis has been given to uncorrelated responses of each detector of a set, but the case of correlated responses leads to obvious extensions of the ideas presented. (auth)

20313 (EUR-5370e, pp 129-133) FAST READOUT SYSTEM FOR MULTIWIRE PROPORTIONAL CHAMBERS. Foglio, R. (institut des Sciences Nucleaires, Grenoble, France); Perrin, C.; Pouxe, J.; Bart, U.; Schwarz, E. Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A fast coincidence and readout system for a set of multiwire proportional chambers is described. It consists of the following elements: preamplifiers, fast or, fast coincidence registers, crate controllers coding and fast rejection unit and a Camac buffer connected to a PDP 11/45 computer. For minimum ionizing pions, the fast OR allows to make coincidences between a chamber plane and a plastic scintillator whose base width is 13 ns. The minimum strobe width of the coincidence registers is 5 ns. The coding time is of the order of 125 ns per word. The system can read up to 16 planes of 512 wires each. (auth)

20314 (EUR-5370e, pp 167-168) DESCRIPTION OF THE DETECTORS WITH THE ASSOCIATED ELECTRONICS USED IN PHOTONUCLEAR REACTIONS AT HIGH ENERGY. Bloch, A. (CEN, Saclay, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The electronics of a proton range spectrometer consisting of a telescope of counters in coincidence are described. The particles are identified by the E, de/dx method. This method requires the control of the gain of the phototubes by light emitting diodes. (auth)

20315 (EUR-5370e, pp 303-306) FAST PROCESSORS FOR ON-LINE TREATMENT OF DATA FROM HIGH-ENERGY PHYSICS EXPERIMENTS. Fucci, A.; Joosten, J.; Letheren, M. F.; Martin, B.; Mazzari, C.; Nierhaus, R.; Verkerk, C.; Vree, W. G. (CERN, Geneva). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A comparison is made of different methods of on-line processing of data from high-energy physics experiments. Some existing hardwired processors are described. The use of processors on-line for filtering of events is considered, with emphasis on input/output requirements. (auth)

20316 (EUR-5370e, pp 307-313) SPECIAL PURPOSE COMPUTING HARDWARE FOR PROCESSING DATA FROM EXPERIMENTS. Maclean, C.; McPherson, G.; Wilde, P. (Rutherford Lab., Chilton, Eng.). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The life of a High Energy Physics experiment is divided into four stages; planning, setting up, data taking and analysis. The first and last of these stages are continually increasing the load on already overworked central computing facilities. This situation may be eased by moving some of the data reduction into the data taking stage, which is generally controlled by a minicom-

puter. Replacing the mini-computer by a faster and more powerful machine is a possible solution but more remarkable gains may be achieved by adding special computing hardware to which the minicomputer acts as a host. This paper outlines the design considerations and architecture of hardware intended for this application, and illustrates its usefulness in an experiment. (auth)

20317 (EUR-5370e, pp 349-354) NEW DEVELOPMENTS IN THE MAGNETOSTRICTIVE READOUT SYSTEM AT SLAC. Bertolucci, B. (Stanford Linear Accelerator Center, CA). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
The present paper describes the work done at SLAC for the magnetostrictive wire spark chambers of SPEAR, LASS and the two-meter streamer chamber. All three are CAMAC systems based on the use of a time digitizer module with different interfacing techniques into three different computers (Sigma 5, PDP-9, PDP-11). Of particular interest is a display controller module that permits wide selection of the data to be displayed. (auth)

20318 (EUR-5370e, 387-394) HIGH ENERGY PHYSICS, CAMAC BASED DATA ACQUISITION AND CONTROL SYSTEM. Bogaerts, A.; Brooks, J. R.; Rudge, A. (CERN, Geneva). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A Camac system interfacing between on IBM 1800 computer and a high energy physics experiment at the CERN Intersecting Storage Rings is described. Camac is used for data acquisition, and also supervises and controls the experiment parameters, providing interactive displays and simplified setting up procedures for the Small Angle Spectrometer at the CERN ISR for studying particle production. (auth)

20319 (EUR-5370e, pp 395-396) CAMAC SEVEN-CRATE SYSTEM ON-LINE WITH AN HP2116B COMPUTER. Cherenenko, S. P.; Chernykh, E. V.; Filatova, N. A.; Ivanov, A. B.; Kolpakov, I. F.; Nikityuk, N. N.; Smirnov, V. A.; Zanevskii, Yu. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A branch of seven CAMAC crates on-line with an HP2116B computer is described. This system is used for data acquisition from a Cherenkov 90-channel spectrometer, 32 magnetostrictive chambers, 20 registers of the proportional chambers, scalers, and hodoscope registers. (auth)

20320 (ISS-T-74/11) USE OF INTEGRATED CIRCUITS FOR AMPLIFICATION AND DISCRIMINATION IN ELECTRONICS FOR DRIFT CHAMBERS. Papadopoulos, L.; Bosio, C.; Cordelli, M. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 3 Oct 1974. 22p. Dep. NTIS (US Sales Only) $3.50.
The MECL integrated differential amplifier are used to design a fast amplifier stage which can be repeated in cascade in dc connection if higher gain is desirable. Such a stage where the MC 10216 is used gives an x3 amplification with a rise time 20 to 80% better than 1.7 ns. The same MECL integrated circuits are also used to design a series of discriminators. In all of them a tunnel diode was used as a trigger element because of its very low trigger level. Output pulses can be either positive or negative and single or complementary, of an amplitude of 0.850 V and width variable up to some nsec. The pulses are compatible to standard NIM. A repetition rate as high as 40 MC/s is obtained, but in some versions a long dead time was the goal. Rise and fall times are as predicted in the manufacture data book. (auth)

20321 (JINR-D1-5969, pp 291-309) SOME PROBLEMS IN THE MASS PROCESSING OF CHAMBER FILMS. Poze, R. 1971. (In Russian)
From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).
In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

20322 (JINR-D1-5969, pp 310-320) PUOS-CONSUL SYSTEM FOR MEASUREMENT OF CHAMBER FILMS. Dubinski, Yu.; Kafka, D.; Mikhalchak, I. 1971. (In Russian)
From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).
In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

20323 (JINR-D1-5969, pp 356-367) BUBBLE CHAMBER FILM MEASUREMENTS OF ZMP. Boettcher, H.; Kaufmann, H. H.; Peter, G. (Institut fuer Hochenergiephysik, Berlin). 1971.
From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).
In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

Film of the CERN 2 m bubble chamber has been measured on both the ZMP (Zeuthener MeBprojektor) and the UMM(Universal-meBmikroskop). The ZMP was developed in the Institute for High Energy Physics in Zeuthen. It is a computer-controlled semi-automatic measuring machine with human road-guidance while the UMM is a hand measuring device. A detailed comparison is presented between the measurements on these two machines and some main proterties of the ZMP such as the measuring accuracy and the reproducibility are discussed. There are no systematic differencies between the track parameters measured on ZMP and UMM. The distribution of the ZMP track residuals has its maximum at 5–6 μm. (auth)

20324 QUICK-OPERATION OF TELEVISION COMPLEX OF FILMLESS INFORMATION READOUT FROM SPARK CHAMBERS. Petrakov, A. V. (All-Union Correspondence Electrical Engineering Inst. of Communications, Moscow). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 9: No. 6, 510-515(1974). (In Russian).
One can see from tha analysis of the time lag characteristics of the growth and readout of vidicon and superorthicon signals that the use of superorthicons increases the quick-operation of the spark chamber–television system–computer by an order of magnitude in comparison with vidicons. (auth)

20325 FAST ELECTRONIC CIRCUIT DESIGNED TO PROCESS ION BEAM IN INTERACTION $\pi^- p \rightarrow X^- p$. Upadhyay, P. N. (Gaya Coll., India). Indian J. Phys.; 49: No. 5, 407-410(May 1975).
A fast trigger circuit for studying $\pi^- + p \rightarrow X^- + p$ and $\pi^- + p \rightarrow X^0 + n$ interactions at nimrod is described. The pion beam is produced by the interaction of a 6-GeV proton beam on a copper target. (WHK)

Radiometric Instruments

Refer also to abstract 20673.

20326 POSSIBILITY OF ESTIMATING THE THICKNESS OF A CLAY CRUST FROM γ-RAY SCATTERING (ACCORDING TO MODELING STUDIES). Korzhev, A. A.; Surguchev, D. G. Prikl. Geofiz.; No. 74, 137-142(1974). (In Russian)
The article shows that maximal values in the intensity of γ radiation over the energy region of 100 to 120 keV observed on differential curves can be used to estimate the thickness of clay crust with a sufficiently high degree of accuracy, since the effect of ore composition, whose effective atomic number varies from 7.42 to 12.39 (water-dry, quartz sand), does not exceed 5% of the radiation which is counted. The linear dependence of the log of the intensity of scattered γ radiation as a function of energy in the Compton region, and also the extremal points of intensity in the zone of multiple scattering (where the photoelectric cross section is comparable to the Compton scattering cross section) can be used to differentiate ores according to effective atomic number Z. (tr-SJR)

20327 DEVELOPMENTS IN ACCURATE NON-CONTACT MEASURING TECHNIQUES. Walton, H. (United Kingdom Atomic Energy Authority Reactor Group, Sellafield, Eng.). J. Br. Nucl. Energy Soc.; 14: No. 4, 341-345(Oct 1975).
A few of the many applications in which a differential charge carrier amplifying system has been used to solve problems in severe environments of radiation, temperature, pressure and noise are illustrated. The accurate non-contact measurement of a reactor fuel element is discussed in detail, as well as the measurement of oxide film thickness and liquid level. The simplicity with which such systems may be engineered is highlighted, together with suggestions for extending the present techniques. (auth)

20328 ION SCATTERING SPECTROMETER UTILIZING CHARGE EXCHANGE PROCESSES. Erickson, R. L.; Smith, D. P. (to Minnesota Mining and Manufacturing Co.). US Patent 3,920,989. 18 Nov 1975. Filed date 20 Sep 1974. 12p.
An ion scattering spectroscopic method and apparatus are described wherein an oscillatory variation in the yield of ions scattered from solid surfaces provides information indicative of electron exchange processes associated with particular electronic states in the atom, which states vary with the electronic environment surrounding the atoms. The apparatus includes means for directing a beam of ions having a known mass and a known charge state toward a solid target surface such that an ion impinges thereon and scatters therefrom. During the impingement, the energy of the incident ions is varied over a range of predetermined primary ion kinetic energies. Ions having a given primary kinetic energy prior to impingement lose a given fraction of that energy upon elastic scattering from an atom of given atomic mass on the target surface. Accordingly, ions scattered from atoms of a single atomic mass are continuously detected by synchronously "tracking" the acceptance energy of an analyzer with the variation in

the kinetic energy of the incident ions. A signal indicative of the yield of ions scattered from atoms having a single atomic mass is thus produced and when plotted as a function of incident primary ion kinetic energy, forms a spectrum wherein particular electronic states may be discerned. (auth)

20329 CONTRIBUTION OF FLUCTUATIONS IN THE PARAMETERS OF THE OBJECT TO THE PROCESS TAKING PLACE AT THE OUTPUT OF A RADIOMETRIC DEVICE. Zav'yalkin, F. M.; Kvasnitsa, M. S. (Tomsk Polytechnic Inst., USSR). Sov. J. Nondestr. Test. (Engl. Transl.); 9: No. 6, 647-650(1973).

Translated from Defektoskopiya; 9: No. 6, 19-23(1973).

The process is described for instances in which statistically specified fluctuations occur in the parameters of the object under test (thickness, linear attenuation coefficient of the flux of radiation). Exact and approximate expressions are derived for calculating the effect of fluctuations in the object parameters on the functional error of the instrument. (Electr. Electron Abstr.)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 20287, 20657, 21828, and 21829.

20330 MECHANISMS OF CHARGE BUILDUP IN MOS INSULATORS. Johnson, W. C. (Princeton Univ., NJ). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2144-2150(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The radiation sensitivity of MOS devices has been recognized to be the result of a charge buildup caused by the sweepout of electrons and the trapping of holes following hole-electron pair production by ionizing radiation. Holes have been shown to have a finite, although small, mobility in thermally grown SiO_2. Trapping of holes takes place near the Si-SiO_2 interface, possibly by oxygen vacancies in the oxide. Normal thermally grown SiO_2 possesses only small concentrations of electron traps. Electron traps have been shown to be generated, however, in the oxide by ion implantation, by irradiation with nonpenetrating electrons, and by exposure of the surface of the oxide to negative ions from a corona discharge. Although Na^+ and Li^+ ions have been shown to be mobile at room temperature in SiO_2, contamination can be kept to levels where ionic charge buildup is negligible. The role of contaminants in the formation of hole traps, however, remains to be determined. (auth)

20331 PROCESS OPTIMIZATION OF RADIATION-HARDENED CMOS INTEGRATED CIRCUITS. Derbenwick, G. F.; Gregory, B. L. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2151-2156(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The effects of processing steps on the radiation hardness of MOS devices have been systematically investigated. Quantitative relationships between the radiation-induced voltage shifts and processing parameters have been determined, where possible. Using the results of process optimization, a controlled baseline fabrication process for aluminum-gate CMOS has been defined. CMOS inverters which can survive radiation exposures well in excess of 10^8 rads (Si) have been fabricated. Restrictions that the observed physical dependences place upon possible models for the traps responsible for radiation-induced charging in SiO_2 are discussed. (auth)

20332 INFLUENCE OF DOSIMETRY ON EARLIER DAMAGE EQUIVALENCE RATIOS. Coppage, F. N. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2336-2339 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Since it was first noted that the experimental damage equivalence ratios for different neutron spectra obtained from change in transistor parameter behavior did not agree with the calculated ratios based on damage to silicon, an explanation has been sought for this apparent discrepancy. Investigations have included device processing techniques device geometry, and finally dosimetry. Careful dosimetry is of the utmost importance to these ratio measurements. Recently extensive studies of the White Sands Fast Burst Reactor (FBR), which is identical to the Sandia Pulsed Reactor (SPR-II), yielded information which suggested that a significant error was possible in the SPR-II dosimetry utilized in earlier studies. A test group at SA1726 (2N4251) transistors were used to make a comparison of the spectrum from the FBR and the SPR-II. The results of the device study showed a difference of 25-30 percent in fluence measured by Sandia dosimetry and by White Sands dosimetry for a given FBR exposure. This difference was for a 10 keV energy threshold. These findings prompted an investigation of the Sandia dosimetry techniques used at SPR-II. This investigation showed, on the basis of dosimetry measurements excluding fission foils, that the 10 keV/3 MeV ratio for SPR-II was 7.5 instead of 10 as presently used. The correction in dosimetry from SPR-II when applied to earlier damage equivalence ratios changes the 14 MeV-to-SPR-II damage ratio from 4.2 to approximately 2.9. This value (2.9) is in good agreement with other experimenters and calculations based on displacement damage in silicon. (auth)

20333 RADIATION-INDUCED SURFACE STATES IN MOS DEVICES. Kjar, R. A.; Nichols, D. K. (Rockwell International, Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2193-2196 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The fact that ionizing radiation causes an increase in both oxide charge and fast surface-state density in MOS devices is well known. The relative role of each damage mechanism in total threshold voltage change with radiation, however, is not always apparent. For example, n-channel MOS transistors using a silicon dioxide gate insulator often show a reversal in the direction of the threshold shift after 10^5 to 10^6 rads(Si) total dose. This reversal could be due to a reduced net oxide charge or an increase in the interface-state density, or some combination of both mechanisms. This paper describes a series of radiation experiments on MOS capacitors which define, in greater detail, the nature of radiation-induced surface states, their dependence on radiation dose and bias, and their dependence on the MOS fabrication process. (auth)

20334 IONIZING RADIATION EFFECTS IN SOS STRUCTURES. Neamen, D.; Buchanan, B.; Shedd, W. (Air Force Cambridge Research Labs., Bedford, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2197-2202(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The total ionizing radiation effects of n-channel enhancement mode silicon on sapphire MISFET's have been characterized up to a total dose of 10^7 rads (Si). The drain current versus drain voltage characteristics of the n-channel devices showing the "kink" effect were measured over a range of gate voltages and as a function of ionizing radiation. The effect of the ionizing radiation on the "kink" phenomenon was determined and the implications of this effect on the radiation hardness of n-channel MISFET's is discussed. The results show that the equivalent threshold voltage at the operating drain voltage must be defined and used in determining the radiation hardness of the n-channel device. The radiation induced back channel leakage currents of n-channel MISFET's are characterized in terms of device geometry and the amount of radiation induced trapped charge in the sapphire substrate. Results showing the leakage current plotted as a function of drain voltage suggest that the "kink" effect and related phenomena also enhance the radiation induced leakage current effects and lead to substantially increased values of leakage current. (auth)

20335 THIN FILM SILICON ON SILICON NITRIDE FOR RADIATION HARDENED DIELECTRICALLY ISOLATED MISFET's. Neamen, D.; Shedd, W.; Buchanan, B. (Air Force Cambridge Research Labs., Bedford, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2203-2207(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The permanent ionizing radiation effects resulting from charge trapping in a silicon nitride isolation dielectric have been determined for a total ionizing dose up to 10^7 rads (Si). Junction FET's, whose active channel region is directly adjacent to the silicon-silicon nitride interface, were used to measure the effects of the radiation induced charge trapping in the Si_3N_4 isolation dielectric. The JFET saturation current and channel conductance versus junction gate voltage and substrate voltage were characterized as a function of the total ionizing radiation dose. The experimental results on the Si_3N_4 are compared to results on similar devices with SiO_2 dielectric isolation. The ramifications of using the silicon nitride for fabricating radiation hardened dielectrically isolated MIS devices are discussed. (auth)

20336 DESIGN OPTIMIZATION OF RADIATION-HARDENED CMOS INTEGRATED CIRCUITS. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2208-2213(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Ionizing-radiation-induced threshold voltage shifts in CMOS integrated circuits will drastically degrade circuit performance unless the design parameters related to the fabrication process are properly chosen. To formulate an approach to CMOS design optimization, experimentally observed analytical relationships showing strong dependences between threshold voltage shifts and silicon dioxide thickness are utilized. These measurements were made using radiation-hardened aluminum-gate CMOS inverter circuits and have been corroborated by independent data taken from MOS capacitor structures. Knowledge of these relationships allows one to define ranges of acceptable CMOS design parameters based upon radiation-hardening capabilities and post-irradiation performance specifications. Furthermore, they permit actual design optimization of CMOS integrated circuits which results in optimum pre- and post-irradiation performance with respect to speed, noise margins, and quiescent power consumption. Theoretical and experimental results of these procedures, the applications of which can mean the difference between failure and success of a CMOS integrated circuit in a radiation environment, are presented. (auth)

20337 DOSE-RATE EFFECTS IN THE PERMANENT THRESHOLD VOLTAGE SHIFTS OF MOS TRANSISTORS. Maier, R. J.; Tallon, R. W. (Air Force Weapons Lab., Kirtland AFB, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2214-2218(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Data have been collected that show the permanent threshold voltage shift occurring in MOS transistors exposed to the same total dose of gamma radiation can be greater in a high dose-rate environment than in a low dose-rate environment. This dose-rate effect is ascribed to a "Photovoltaic" bias generation in the substrate of a device which results in an effective gate bias change (positive for P-channel and negative for N-channel transistors). The bias change ranges from 0 to +-1 volt during the radiation burst. Thus, in a high dose-rate ionizing environment, the permanent gate threshold voltage shift of a MOS device, which is known to be a function of the gate bias during irradiation, will exhibit an indirect dose-rate dependence which is caused by an internal change in instantaneous gate bias. (auth)

20338 PROCESS CONTROLS FOR RADIATION-HARDENED ALUMINUM GATE BULK SILICON CMOS. Gregory, B. L. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2295-2302(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Optimized dry oxide processes have recently yielded notable improvements in CMOS radiation hardness. For these processes to be manufacturable, controls and screens are required to allow both manufacturer and user to guarantee survival of specific radiation environments. Four aspects of controlling a radiation hardened process are discussed. The electrical characteristics and constraints of a hardened technology are outlined. The statistical relations between radiation survival probability and process hardness capabilities are developed. The process steps which are key to achieving hardness are identified and the required controls on these steps are determined. Finally, the subject of hardness screening is explored to determine necessary actions, prerad and postrad, to insure that radiation requirements are met. (auth)

20339 TERMINAL MEASUREMENTS FOR HARDNESS ASSURANCE IN TTL DEVICES. Johnston, A. H.; Skavland, R. L. (Boeing Aerospace Co., Seattle). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2303-2307(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A new electrical correlation parameter is described which correlates with neutron damage in TTL integrated circuits. This measurement can be applied to the majority of TTL device types using the normal device pinout, eliminating any requirement for custom metallization patterns. The correlation is based on the analytical relationship between V/sub BE/ and base-transit time for internal transistors within the integrated circuit. Examples of the effectiveness of this correlation parameter are included for 54L and 54 series TTL devices, along with suggested applications to hardness assurance programs. (auth)

20340 HARDNESS ASSURANCE CONSIDERATIONS FOR THE NEUTRON ENVIRONMENT. Messenger, G. C. (Rockwell International Corp., Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2308-2313(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Two related questions pertaining to neutron hardness assurance technology are examined. (1) How much statistical variability in neutron response is present when the same product is manufactured by two different companies on controlled lines. (2) How does circuit design margin affect neutron failure probability. A large body of statistical data on semiconductor device neutron degradation has been accumulated at Rockwell International covering procurement from several manufacturers over approximately five years. The data has shown that the neutron radiation response usually differs by less than a factor of two when comparing the same device from two manufacturers; furthermore, the neutron radiation response of a specific device usually varies by less than a factor of two from the line average when compared over a period of several years. At a selected failure probability, the failure fluence divided by the circuit design safety margin is approximately constant over a wide range of selected failure probabilities and design safety margins. (auth)

20341 UNIFIED MODEL OF DAMAGE ANNEALING IN CMOS, FROM FREEZE-IN TO TRANSIENT ANNEALING. Sander, H. H.; Gregory, B. L. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2157-2162(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Irradiation studies at 76^{0}K are described which demonstrate that radiation-produced holes in SiO_2 are immobile at this temperature. If an electric field of either polarity is present in the SiO_2 during 76^{0}K irradiation, to sweep out the mobile electrons, the holes will virtually all be trapped where created and produce a uniform positive charge density in the oxide. This predicts DELTA V/sub T/ varies as d^2/sub ox/, which is observed. The magnitude of the observed shift is consistent with 18 eV required per hole-electron pair generated. All CMOS transistors of the same oxide thickness exhibit the same initial DELTA V/sub T/, for a given exposure level, regardless of oxide type or process. The rate of annealing differs, both as a function of oxidation process and oxide thickness. Thin oxides have two advantages: a smaller DELTA V/sub T/ (stable shift) and faster annealing. If a CMOS device is irradiated for sufficient time at 76^{0}K to build in an appreciable field, further irradiation with zero gate-substrate bias will produce little additional change in V/sub T/, since the field in the oxide tends to keep all generated electrons in the oxide, where they recombine with trapped holes. Room temperature annealing following a pulsed gamma exposure occurs in two regimes. The first regime can be quite fast, and occurs prior to 10^{-4} seconds. The magnitude of this early-time recovery is both process dependent and thickness dependent. In a hardened device most of the damage anneals during this early-time stage, whereas in a typical non-hardened unit the early-time stage (recovery) can be quite small. (auth)

20342 HOLE TRANSPORT AND CHARGE RELAXATION IN IRRADIATED SiO_2 MOS CAPACITORS. Boesch, H. E. Jr.; McLean, F. B.; McGarrity, J. M.; Ausman, G. A. Jr. (Harry Diamond Labs., Adelphi, MD). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2163-2167(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The transient response of SiO_2 gate-insulator MOS capacitors to pulsed electron beam irradiation was studied. The radiation-induced flatband voltage shift (DELTA V/sub FB/) in SiO_2 MOS capacitors was measured with a fast C–V technique from 70 mu sec to 1000 sec after a 60 krad radiation pulse for temperatures from 80 to 293 K. In complementary experiments, the post-irradiation charge displacement in the MOS capacitors was measured with an integrating picoammeter. By correlating the relaxation of the flatband voltage with integrated current measurements, it was established that the measured response is dominated by hole transport and trapping in the SiO_2 film. The temporal and temperature dependences of the hole transport are well described by a stochastic hopping model based on a continuous time random walk (CTRW). The essential feature of the CTRW is that the transport occurs via a carrier hopping (phonon assisted) process between localized sites randomly distributed in the amorphous SiO_2. Since the carriers do not require excitation to the band edges in order to be mobilized, the activation energy for conduction (tunneling) is independent of the optical excitation energy. (auth)

20343 EFFECT OF ION IMPLANTATION ON OXIDE CHARGE STORAGE IN MOS DEVICES. Wang, S. T.; Royce, B. S. H.; Russell, T. J. (Princeton Univ., NJ). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2168-2173(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Measurements are reported in which the charge stored in the oxide of an MOS device exposed to ionizing radiation is studied as a function of oxide pretreatment. Implantation with Al^+ ions is found to introduce electron traps into the oxide and the stability of these traps is examined in thermal annealing experi-

ments. The predictions of a simple model, in which the implantation associated displacement damage is considered to be the source of the additional electron traps, are compared to the experimental observations. (auth)

20344 PHYSICAL MECHANISMS OF RADIATION HARDENING OF MOS DEVICES BY ION IMPLANTATION. Curtis, O. L. Jr.; Srour, J. R.; Chiu, K. Y. (Northrop Research and Tech. Center, Hawthorne, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2174-2180(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

This paper reports experimental and analytical studies performed on Al^+ ion-implanted MOS capacitors. Electrons and holes were excited in SiO_2 by a low-energy electron beam, the resultant current measured, and the results then compared to findings for unimplanted specimens. Comparisons were also made of flatband voltage shifts for implanted and unimplanted devices. Analytical expressions, based on a physical model, are developed which explain the experimental results. In this model, decreases in collected current and changes in flatband voltage shift are attributed to both hole and electron trapping in the implanted region. Thus, the model contains three critical parameters: the mobility-lifetime products for both holes and electrons in the implanted region and the depth of this region. While a range of these variables satisfy either the current vs voltage measurements or the flatband-voltage-shift results, considered jointly these experiments provide specific values for all three parameters. The depth of the implanted region so determined agrees well with experimental observation, and the mobility-lifetime products calculated for different experimental conditions are consistent. The product for holes (approximately 3.5×10^{-13} cm^2/V) is substantially smaller than that for electrons (approximately 2×10^{-12} cm^2/V), indicating that holes are more easily trapped in the implanted zone than electrons. The fact that more electrons than holes are actually trapped in the case of gamma irradiation under positive bias is explained by the model. Bias dependence is also explained, as well as the fact that there is an optimum implantation energy for minimizing flatband shifts. (auth)

20345 RADIATION HARDENED CMOS/SOS. Aubuchon, K. G.; Harari, E. (Hughes Aircraft Co., Newport Beach, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2181-2184(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

This paper reports the results of experiments designed to optimize the total dose ionizing radiation hardness of CMOS/SOS devices. Type 4007 inverter circuits were fabricated with variations in the process, including wet versus dry gate oxidation. Tolerable values (e.g. less than 1 mu A per mil of channel width) of post-radiation n-channel back leakage were obtained only with wet oxides. Threshold shifts of less than or equal to 1V for the n-channel devices and less than or equal to 2V for the p-channel devices were obtained after 10^6 rads (Si) on the best devices fabricated. (auth)

20346 INVESTIGATION OF RADIATION EFFECTS AND HARDENING PROCEDURES FOR CMOS/SOS. Peel, J. L.; Pancholy, R. K.; Kuhlmann, G. J.; Oki, T. J.; Williams, R. A. (Rockwell International, Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2185-2189(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Ionizing radiation effects and hardening procedures have been investigated using simple CMOS/SOS circuits fabricated with SiO_2 gate insulators. A modified gate oxidation process using steam and HCl has resulted in improved gate oxide hardness—with threshold voltage shifts of less than two volts up to a total dose of 10^6 rads(Si). Radiation-induced n-channel leakage currents were reduced by more than two orders of magnitude by using a deep boron ion implant and appropriate processing techniques. Post-irradiation values of less than 0.5 mu A/mil have been obtained using this procedure. Studies of charge buildup at the silicon-sapphire interface indicate an effective positive charge in the range of 10^{11} cm^{-2} to 10^{12} cm^{-2}—peaking at a total dose of about 10^5 rads (Si). This effective charge decreases for increasing doses above 5×10^5 rads(Si). The decrease is attributed to radiation-induced interface states. (auth)

20347 RADIATION HARDENING OF MOS INTEGRATED CIRCUITS ON [111] SILICON. Philips, D. H. (Rockwell International, Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2190-2192(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Effective procedures have been developed for hardening MOS transistors by minimizing radiation-induced threshold-voltage shifts in the SiO_2 gate insulator. These existing procedures were developed primarily for [100] oriented silicon. The radiation-hardening work reported herein was based upon specific requirements for use of [111] oriented silicon. The objective of this study was to evaluate the effectiveness of existing gate-insulator radiation-hardening procedures when applied to PMOS integrated circuits fabricated on [111] bulk silicon substrates. These procedures were proven effective in hardening [111] PMOS integrated circuits. However, there remains a significant difference between the radiation hardness of [111] and [100] PMOS integrated circuits. (auth)

20348 EFFECT OF RADIATION DAMAGE ON THE NOISE PERFORMANCE OF FET'S. Chiwaki, M.; Tomimasu, T. (Electrotechnical Lab., Tokyo). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2696-2702(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The gate noise from radiation induced defects in MOSFET's and JFET's has been studied for 24.8 MeV electron irradiations up to about 1×10^{16} e/cm^2. The flicker noise increase induced in JFET's has been interpreted as due to the defect generation and recombination centers induced by radiation damage within the depletion layer. Finally, it is shown that the noise performance of JFET's is well applicable for high-intensity and high-level radiation detection. (auth)

20349 RADIATION HARDNESS OF A HIGH SPEED ECL MICROCIRCUIT. Daniel, M. E.; Coppage, F. N. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2595-2599(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The evaluation covered in this paper describes a radiation tolerant circuit capable of operation at frequencies greater than 100 MH/sub Z/ that can be fabricated in LSI form. The circuit evaluated consists of master-slave flip-flops, AND gates, OR gates, and EXOR gates. A standard ECL process incorporating special circuit techniques results in a circuit that operates at high frequencies and dissipates only a moderate amount of power. The circuits tested were operational (gave the proper digital response) after exposure to 2.5×10^7 rads (Si) and after exposure to 1×10^{15} n/cm^2 (E greater than 10 keV). Little testing has been reported for ECL or other very high speed circuitry in a radiation environment. This paper describes the processing, including layout dimensions, with particular emphasis on the techniques inherent to the technology that provide radiation tolerance. The special test circuit is described, results of the high speed tests are discussed, and comments are made on the use of high-speed logic circuits in radiation environments. (auth)

20350 RADIATION DAMAGE TO INTEGRATED INJECTION LOGIC CELLS. Pease, R. L. (Naval Weapons Support Center, Crane, IN); Galloway, K. F.; Stehlin, R. A. IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2600-2604(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The effects of neutron and total dose gamma irradiations on the electrical characteristics of an integrated injection logic (I^2L) cell and an I^2L multiple inverter circuit were investigated. These units were designed and fabricated to obtain circuit development information and did not have radiation hardness as a goal. The following parameters of the test structures were measured as a function of total dose and neutron fluence: the dc common-base current gain of the lateral pnp transistor; the dc common-emitter current gain of the vertical npn transistor; the forward current-voltage characteristics of the injector-substrate junction, and the propagation delay versus power dissipation per gate for the multiple inverter circuit. The limitations of the present test structures in a radiation environment and possible hardening techniques are discussed. (auth)

20351 RADIATION EFFECTS ON BIPOLAR INTEGRATED INJECTION LOGIC. Raymond, J. P.; Wong, T. Y.; Schuegraf, K. K. (Northrop Research and Tech. Center, Hawthorne, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2605-2610(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Integrated Injection Logic (I^2L) is a new high-density, low power bipolar LSI technology that offers major performance advantages over other bipolar and MOS/LSI technologies. Results are presented on the experimentally-determined radiation susceptibility of developmental unhardened I^2L LSI logic cells in terms of neutron-induced displacement damage, ionizing-dose-induced surface effects and transient photoresponse. (auth)

20352 MOS MODELING HIERARCHY INCLUDING RADIATION EFFECTS. Alexander, D. R.; Turfler, R. M. (The BDM Corp., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2611-2616(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A hierarchy of modeling procedures has been developed for MOS transistors, circuit blocks, and integrated circuits which include the effects of total dose radiation and photocurrent response. The models were developed for use with the SCEPTRE circuit analysis program, but the techniques are suitable for other modern computer aided analysis programs. The modeling hierarchy permits the designer or analyst to select the level of modeling complexity consistent with circuit size, parametric information, and accuracy requirements. Improvements have been made in the implementation of important second order effects in the transistor MOS model, in the definition of MOS building block models, and in the development of composite terminal models for MOS integrated circuits. (auth)

20353 CMOS/SOS NAND GATE SAPPHIRE PHOTOCURRENT COMPENSATION. Phillips, D. H. (Rockwell International Corp., Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2617-2620 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The analysis summarized below is applicable to the design of radiation-hardened CMOS/SOS NAND gates, having any number of inputs. Derivations and general solutions have been developed to allow the consideration of any combination of input logic signals. This analysis method can be extended to CMOS/SOS NOR gates and is directly applicable to CMOS/SOS inverters when the NAND gate model is exercised as a single-input circuit. Silicon-on-sapphire construction greatly reduces junction photocurrents in MOS circuits. However, a "resistive" current path through the normally insulating sapphire substrate can occur due to radiation-induced carrier generation in the sapphire. Current flowing through this photoresistive path accounts for most of the SOS transistor drain photocurrent observed experimentally. This analysis develops design rules for optimizing the dose-rate radiation hardness of CMOS/SOS digital NAND gates including SOS photoconduction effects. The work reported herein extends the application of existing sapphire photocurrent compensation methods. (auth)

20354 PROPERTIES OF FULLY DECODED 256 BIT PMNOS/PMOS/SOS/AL-GATE MEMORY IN RADIATION ENVIRONMENT. Brucker, G. J. (RCA Astro Electronics Div., Princeton, NJ). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2621-2628(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Tests were conducted to characterize a fully decoded 256 bit PMNOS memory in a nuclear environment. These tests were as follows: (1) transient photocurrent tests using 20 ns and 100 ns electron pulses from the AFCRL Linac, (2) transient annealing tests using 4.5 mu s electron pulses from the same Linac and also 365 mu s to 2.5 ms gamma pulses from the Aberdeen Pulse Reactor with doses up to 6×10^4 rads (Si) and neutron fluences up to 2.6×10^{13} n/cm^2 pulse, (3) survivability tests using 20 ns gamma pulse from the AFCRL Flash x-ray, and (4) total dose using cobalt-60 source at ECOM, Evans Laboratory. The results show that predictions of failure levels based on measurement made on the elementary devices are reasonably accurate. In addition, the results show that total dose hardness levels of 3×10^5 rads (Si) can be achieved without the use of hardened insulators. Most of the various failure levels were determined by the PMOS radiation effects. (auth)

20355 ELECTRICAL AND RADIATION CHARACTERISTICS OF MOS/SOS LINEAR DEVICES. Nielsen, R. L.; Butcher, D. T.; Ronen, R. S. (Rockwell International, Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2629-2633(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The potential of MOS devices for application to radiation-hardened digital systems has been recognized for several years. However, MOS devices have not been widely used for linear applications in integrated circuits (MSI or LSI)—even though integration of analog and digital MOS functions on the same chip can provide significant advantages in volume, power, and reliability. The advantages result primarily from a substantial reduction in the number of packages required to perform a given subsystem function. In addition, the overall (potential) radiation hardness of linear MOS/SOS structures is the highest of any low-power linear technology. This paper summarizes the characteristics of MOS/SOS building blocks and circuits fabricated specifically to define optimum design parameters and design techniques for linear MOS/SOS circuits. Meaningful statistical data, which outline the capabilities and limitations of MOS/SOS linear integrated-circuit functions, are also presented. Finally, the effects of radiation on a building-block linear integrated circuit are described in detail. (auth)

20356 EFFECTS OF IONIZING RADIATION ON A 256-STAGE LINEAR CCD IMAGER. Killiany, J. M.; Saks, N. S.; Baker, W. D. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2634-2638(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The total dose effects of gamma radiation on an unhardened 256-stage linear CCD imager have been investigated. Key device parameters were monitored and the primary failure mechanisms identified. Additional structural design rules for radiation hard CCD's were formulated. The performance of a threshold insensitive input technique was evaluated. (auth)

20357 RADIATION EFFECTS IN CHARGE COUPLED DEVICES. Williams, R. A.; Nelson, R. D. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2639-2644(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Charge coupled devices (CCDs) exhibit a number of advantages (low cost, low power, high bit density) in their several applications (serial memories, imagers, digital filters); however, fairly elementary theoretical considerations indicate that they will be very vulnerable to permanent radiation damage, by both neutrons and ionizing radiation, and to transient upset by pulsed ionizing radiation. Although studies of permanent ionizing-radiation damage in CCD's have been reported, little information has been published concerning their overall nuclear radiation vulnerability. This paper presents a fairly comprehensive experimental study of radiation effects in a 256-cell surface-channel, CCD shift-register. A limited amount of similar work is also presented for a 128-cell surface-channel device and a 130 cell peristaltic CCD shift register. The radiation effects phenomena discussed herein, include transient-ionizing-radiation responses, permanent ionizing-radiation damage to transfer efficiency, charge-carrying capacity and input transfer gate bias, and neutron damage to storage time—determined from dark current and charge-up time measurements. (auth)

20358 MODELING SECOND BREAKDOWN IN PN JUNCTIONS WITH NET-2. Lutzky, M.; Dean, E. B. Jr.; Petree, M. C. (Naval Surface Weapons Center, Silver Spring, MD). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2645-2649(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A diode model has been constructed which simulates second breakdown and which allows for the calculation of junction temperature as a function of time in the reverse region. The model was generated for the NET-2 circuit analysis code, and also includes avalanche breakdown. Second breakdown is assumed to begin at the critical temperature at which the resistivity is a maximum; at this point the junction area is caused to rapidly decrease, causing an increase in the temperature and the thermally generated leakage current. This results in the rapid voltage drop characteristic of second breakdown. With the addition of temperature calculations in the forward region and capacitive effects, it is anticipated that the model will be useful for predicting second breakdown for general inputs, and in general circuit configurations. (auth)

20359 INVESTIGATION OF JI AND DI CMOS FXR RESPONSE AT DIFFERENT SPECTRAL ENERGIES. Honnold, V. R.; Goldberg, M.; Schreiner, W. A.; Witteles, A. A. (TRW Systems Group, Redondo Beach, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2650-2655(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The transient response of both junction isolated (JI) and dielectrically isolated (DI) CMOS circuits has been investigated in three FXR environments of differing energy spectrums. The offset recovery times have been measured and analyzed for both structures. It is shown that while the DI circuit (HD4007) did not exhibit a four layer type latchup action, its transient response persisted for a time longer than is expected for this type of device. A possible mechanism for this observed response is developed and discussed. JI circuits (CD4007) exposed under the same conditions exhibited four layer device action and one sample at low spectral energies latched-up. The conditions for the latchup to occur including the four layer device paths are discussed. Finally, the dependence of the x-ray transient response on the spectral energy is considered. For the lower energy FXR source, latchup was observed in a CD4007 sample. This latchup was not observed at more than double the dose rate when a high energy FXR was used. This result is attributed to dose enhancement, and a device enhancement factor may also be involved. The dose enhancement factor is estimated from the work of Long, and points up the importance of accounting for the spectral energy content in simulating a given nuclear threat spectrum. (auth)

20360 ELECTRON AND PROTON DAMAGE COEFFICIENTS IN LOW-RESISTIVITY SILICON. Srour, J. R.; Othmer, S.; Chiu, K. Y. (Northrop Research and Technology Center, Hawthorne, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2656-2662(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Electron and proton damage coefficients have been determined for low resistivity silicon based on minority-carrier lifetime measurements on bulk material and diffusion length measurements on solar cells. Major observations made and conclusions reached are the following. (1) Diffusion-length damage coefficients (K/sub L/) increase with decreasing resistivity (rho) for boron-doped silicon. For 0.5-, 1.0-, and 2.5-MeV electron bombardment, empirical fits to experimental data can be approximately expressed as K/sub L/ varies as rho/sup -⅔/ for 0.1 less than or equal to rho less than or equal to 20 ohm-cm. For 10-MeV proton bombardment, an empirical fit of the form K/sub L/ varies as $rho^{-0.44}$ was found to describe the data reasonably well. (2) The dependence of damage coefficient on resistivity can be qualitatively accounted for quite well using a two-level Hall–Shockley–Read model. (3) Damage coefficients for solar cells were observed to be larger than their bulk-material counterparts. (4) Bulk samples and solar cells prepared from float-zone material were generally observed to be more radiation tolerant than their Czochralski counterparts at all resistivities examined. (5) No dependence of damage coefficient on dislocation density was apparent for 0.1 ohm-cm bulk samples and solar cells. (auth)

20361 CORRELATION OF DISPLACEMENT EFFECTS PRODUCED BY ELECTRONS, PROTONS, AND NEUTRONS IN SILICON. van Lint, V. A. J.; Gigas, G.; Barengoltz, J. (California Inst. of Tech., Pasadena). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2663-2668(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The correlation of displacement effects produced by electrons, protons, and neutrons in silicon is studied. Available data from the literature is employed. In particular the scope of the study is limited to the degradation of excess carrier lifetime and device electrical parameters directly related to it. The degree to which displacement effects may be correlated in order to predict semiconductor device response based on response data to another type of radiation is discussed. Useful ranges of the correlation factors (K/sub tau/ ratios) as a function of device majority carrier type, device resistivity, and injection level are presented. A significant dependence on injection level for the correlation factors is found. (auth)

20362 HARDENING OF MJS77 SPACECRAFT AGAINST THE JUPITER RADIATION BELTS. Price, W. E.; Stanley, A. G. (Jet Propulsion Lab., Pasadena, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2669-2674(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The Mariner Jupiter/Saturn spacecraft (MJS77) will be launched in 1977 and fly by Jupiter in 1979. Pioneer spacecraft have measured large fields of electrons and protons trapped in the Jupiter magnetic field. Because these radiation fields are potentially damaging to the sophisticated electronic systems of MJS77, it was necessary to initiate a program to radiation-harden the systems. This paper presents the results of parts-radiation studies, the purpose of which is to provide devices capable of meeting the environmental requirements or data from which to determine how to harden the circuits or to shield the parts. In the device-characterization tests, the general radiation sensitivity levels of approximately 200 different device types were determined under the specific conditions used in the spacecraft. The shielding includes both specific shaped shields and natural shielding of the spacecraft, where sensitive parts are rearranged to be placed deep within the package, so as to take advantage of the energy absorption of less sensitive materials and parts. In device screening, a number of radiation-sensitive device types are irradiated to determine acceptability and level of damage of each diffusion or wafer lot. The device-characterization program is nearly complete, but only a limited amount of screening has been completed to date. IRAN screening is in its preliminary stages. A considerable amount of experimental work has been done in linear devices. A very limited amount of flight parts has been tested. (auth)

20363 SATELLITE ANOMALIES FROM GALACTIC COSMIC RAYS. Binder, D.; Smith, E. C.; Holman, A. B. (Hughes Aircraft Co., Culver City, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2675-2680(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Anomalies in communication satellite operation have been caused by the unexpected triggering of digital circuits. Interactions with galactic cosmic rays were investigated as a mechanism for a number of these events. The mechanism assumed was the charging of the base-emitter capacitance of sensitive transistors to the turn-on voltage. The calculation of the cosmic ray event rate required the determination of transistor parameters, charge collection efficiencies, and the number of sensitive transistors. The sensitive transistors were determined by analyzing the results of a scanning electron microscope experiment. Calculations with iron cosmic rays resulted in an event rate of 3.1×10^{-3} per transistor per year, in reasonable agreement with the observed rate of 1.5×10^{-3}. (auth)

20364 HARDENING OF SOLAR CELLS AGAINST LOW-ENERGY REAR-INCIDENT PROTONS. Fischer, C. J.; Kalma, A. H. (IRT Corp., San Diego, CA). NS-22: No. 6, 2681-2684 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The damage mechanisms resulting from normally incident low-energy proton irradiation on the back side of standard n/p silicon solar cells have been investigated, and an evaluation was performed of cells modified to better withstand back irradiation. The damage effects produced by the low-energy rear-incident protons resulted in the formation of an additional junction at the back contact and an increase in effective series resistance, indicating the removal of majority carriers at the damaged region. The proton irradiation caused an injection level dependence of the spectral response; the spectral response degradation at high injection levels was greater than at low injection levels. The results of the evaluation of the modified cells indicate that the n/p solar cells with a p^+-doped-back surface are less sensitive to normally rear-incident low-energy proton irradiation. Sensitivity to this type radiation also decreases with increasing cell thickness. (auth)

20365 COMPARISON OF FAST NEUTRON IRRADIATION EFFECTS IN PHOTOCONDUCTIVE AND PHOTOVOLTAIC InSb INFRARED DETECTORS. Wilsey, N. D.; Guenzer, C. S.; Molnar, B.; Moore, W. J. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2448-2455(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The relative neutron irradiation hardness of photoconductive and photovoltaic InSb infrared detectors is examined for various operating modes and conditions. It is found that photoconductors are much less vulnerable to fast neutrons at 78°K than are photovoltaic detectors. The damage mechanisms for photovoltaic detectors are increased leakage currents coupled with a decrease of minority carrier lifetime in the bulk region with a damage constant of 1.5×10^{-14} mu $m^{-2}n^{-1}cm^2$, while a carrier removal rate of 1.1 cm^{-1} is established for 14 MeV neutron-irradiated p-type InSb with an initial carrier concentration of approximately 3×10^{14} cm^{-3}. It is shown that these changes in material parameters can be used to predict fast neutron damage under all realistic operating conditions. The effects of neutron irradiations on signal, noise, current-voltage characteristics and spectral response are discussed in detail. (auth)

20366 NUCLEAR RADIATION INDUCED NOISE IN INFRARED DETECTORS. Pickel, J. C.; Petroff, M. D. (Rockwell International, Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2456-2461(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A model for calculating the rate and amplitude of gamma ionization events in infrared detectors is presented. Several simplifying approximations to the actual, complex physical situation are applied in the model, thereby allowing an exact analytical formulation of the problem. Experimental measurements of nuclear-radiation induced noise pulse-height distributions and event rates are compared to predictions made using the model. Comparisons of experiment and theory were made at several different gamma energies to provide confirmation of the model over the gamma energy range of interest of most application. The experimentally-confirmed model allows prediction of the noise response of photoconduction detectors for any specified detector material, geometry, surrounding material and incident gamma spectrum. (auth)

20367 RADIATION RESISTANT FIBER OPTIC MATERIALS AND WAVEGUIDES. Evans, B. D.; Sigel, G. H. Jr. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2462-2467(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The ionizing radiation response of a variety of radiation resistant bulk glasses and optical fibers has been measured. The spectral character and time dependence of the radiation-induced optical losses in high purity silicas and silica-containing fibers has been determined for a range of doses and dose rates. Intrinsic optical loss and radiation response measurements on several types of cerium-protected silicate glasses and fibers have indicated that moderate loss (approximately 100 db/km), high numerical aperture, radiation resistant fiber waveguides are achievable by cerium doping of silicates provided that sufficiently pure materials are utilized. Total fiber loss data, that is, radiation-induced loss plus intrinsic loss, have been generated vs time following pulsed irradiation. (auth)

20368 ABSORPTION INDUCED IN OPTICAL WAVEGUIDES BY PULSED ELECTRONS AS A FUNCTION OF TEMPERATURE, LOW DOSE RATE GAMMA AND BETA RAYS, AND 14 MeV NEUTRONS. Mattern, P. L.; Watkins, L. M.; Skoog, C. D.; Barsis, E. H. (Sandia Labs., Livermore, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2468-2474(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Three separate studies of radiation-induced absorption in glass and plastic waveguides have been completed. First, the absorption induced by low dose-rate ^{60}Co gamma rays and ^{90}Sr beta rays has been measured and compared with results obtained using higher dose rates. The comparison shows the absorption is independent of dose-rate from 500 rads/day to 10^6 rads/day to total doses of 6×10^4 rads. Second, the absorption induced in optical fibers by 14 MeV neutrons has been measured. The data were compared with results from ^{60}Co gamma-ray irradiations using calculated values of the neutron ionizing dose as a basis of comparison. The results show that the absorption induced by 14 MeV neutrons at the fluences reported here is determined by the neutron ionizing dose in the spectral region from 400 nm to 1100 nm. Third, the effects of temperature on the transient absorption following pulsed electron irradiation have been measured. Predictions from kinetic models for geminate recombination, tunneling, thermal untrapping, and impurity-associated scavenging were compared with the experimental data. The results appear to identify kinetic processes that determine recombination in various irradiated waveguides. (auth)

20369 EFFECT OF GAMMA IRRADIATION ON OPTICAL ISOLATORS. Soda, K. J. (Air Force Weapons Lab., Kirtland AFB, NM); Barnes, C. E.; Kiehl, R. A. IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2475-2481(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The effects of gamma radiation on optical isolators have been investigated. This study has included the simultaneous irradiation and measurement of the individual emitters and detectors making up the isolators. In this manner, the net effect of irradiation on the isolators could be attributed to the degradation of either the emitter or detector, or both. As expected, isolators containing photodiodes are more radiation resistant than those containing phototransistors. In the photodiode isolator the LED is responsible for essentially all the gamma-induced isolator degradation. The performance of phototransistor isolators depends strongly on the phototransistor bias, V/sub CE/, and the LED input current, I/sub LED/. At high I/sub LED/ and low V/sub CE/ where gamma-induced surface effects in the phototransistor are minimized, the degradation of the isolator is due primarily to the LED which is more sensitive than the LED in the photodiode isolator. In contrast, at low I/sub LED/ and high V/sub CE/, gamma-induced surface damage in the phototransistor is the dominant effect and the isolator is quite sensitive to irradiation. (auth)

20370 RADIATION DAMAGE CONSTANTS OF LIGHT-EMITTING DIODES BY A LOW-CURRENT EVALUATION METHOD. Hum, R. H.; Barry, A. L. (Communications Research Centre, Ottawa). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2482-2487(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

An optimum technique has been devised for measuring radiation damage constants of LED's, which avoids "injection annealing" of the damage that can occur during post-irradiation evaluation. It is shown that the low current densities necessary to avoid this annealing may require that measurements be made at constant junction voltage, and may preclude the use of the reverse-charge-recovery technique for direct measurement of carrier lifetime. The correction necessary for the varying voltage drop across the diode series resistance is facilitated by the low measuring currents, and by a novel technique for the accurate measurement of diode series resistance at low currents. Precise measurement techniques permit damage constants to be evaluated by application of only a small radiation dose. Using this method, proton, neutron, and gamma damage constants have been evaluated for commercial (Texas Instruments TIXL-13) GaAs LED's. Agreement between the damage constant describing degradation at these low current densities and the higher levels used in practical applications has been verified. (auth)

20371 TRANSIENT IONIZING RADIATION EFFECTS ON BARITT DIODE OSCILLATORS. Borrego, J. M.; Gutmann, R. J.; Narain, J. (Rensselaer Polytechnic Inst., Troy, NY). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2488-2493(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The performance of a variety of BARITT diode oscillators has been measured under transient ionizing radiation conditions. Two to five milliwatt cw silicon diode oscillators (Schottky and diffused injecting junctions) were exposed to 100 nanosecond pulses of 10 MeV electrons at dose rates between 10^7 and 10^{10} rads/sec. With these oscillators, the RF power is reduced at increasing dose rates and is quenched entirely during the radiation pulse at a dose rate dependent upon junction characteristics. The RF power remains quenched after the radiation pulse for approximately 500 nanoseconds in some diodes due to charge storage. The charge storage is related to the injection efficiency of the injecting contact, increasing in duration as the injection efficiency increases. Besides this temporary stored charge, no aftereffects were observed in any of the diodes. (auth)

20372 EMP SUSCEPTIBILITY OF INTEGRATED CIRCUITS. Jenkins, C. R.; Durgin, D. L. (BDM Corporation, Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2494-2499(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

This paper summarizes the results of a major test program which involved the measurement of the pulse power failure thresholds of 41 integrated circuit types, representing seven logic families. The pulse widths used in these tests range from 0.1 microsecond to 10 microseconds. The failure threshold data have been grouped by logic family and test terminal to form failure categories. gories. A simple failure model has been developed which is useful in predicting the failure thresholds of untested devices. (auth)

20373 TRANSISTOR COLLECTOR BREAKDOWN IN THE PRESENCE OF CONDUCTED EMP AND GAMMA RADIATION. Rice, D. H. (GTE Sylvania, Needham, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2500-2502(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

In this paper we develop expressions which describe breakdown, negative resistance and latch characteristics for a common emitter transistor when exposed to simultaneous conducted EMP and ionizing radiation. These expressions are derived from a modified Ebers-Moll model and show that common emitter breakdown voltage is reduced, latch (or sustaining voltage) remains unchanged, and that the negative resistance characteristics are changed. Using the modified Ebers-Moll model good agreement between predicted and observed circuit response is demonstrated when the circuits are exposed to a rising collector voltage (due to EMP) and simultaneous ionizing (gamma) radiation. (auth)

20374 EFFECTS OF PULSED IONIZING RADIATION ON THE OPERATION OF SURFACE ACOUSTIC WAVE AMPLIFIER AND CONVOLVERS. Berg, N.; Udelson, B. J. (Harry Diamond Labs., Adelphi, MD). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2503-2509 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

In a previous paper (IEEE Trans. Nucl. Sci.; NS-21: No. 6, 141 (1974)) we described the effects of transient ionizing radiation on passive surface acoustic wave (SAW) devices and also the permanent displacement damage resulting from high-energy nuclear radiation on the operation of a SAW monolithic amplifier. This paper will conclude the study of the effects of transient ionizing radiation on SAW devices by presenting the effects of a short-duration, high-intensity ionizing radiation pulse on the SAW amplifier, various SAW convolver structures and reflective-array pulse compression (RAC) filter device. By way of brief summary, the operation of the amplifier was found to be relatively unaffected by short-duration radiation pulses, whereas many of the convolver structures were affected by the radiation. A long-term change in phase as a result of radiation was found in the RAC device, and this change is postulated to result from a radiation-induced temperature change. (auth)

20375 ELECTRICAL PULSE BURNOUT TESTING OF LIGHT-EMITTING DIODES. Kalma, A. H.; Fischer, C. J. (IRT Corporation, San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2510-2515(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Electrical pulse burnout thresholds were measured in GaAs, GaAsP, and GaP light-emitting diodes (LEDs) by studying the degradation in light output and the change in I-V characteristics both during the pulse and in the steady state. Pulse widths ranging from a few hundred nsec to 100 mu sec were used. Light output degradation was the most sensitive parameter and was used to determine the thresholds. Just above threshold, damage is caused by an increase in generation-recombination current in the space-charge retion. This current is non-radiative and the light output drops, but the damage is not catastrophic. At higher power, the junction burns through and shunt resistance paths are formed which more drastically degrade the light output. The experimental data match reasonably with the theoretical Wunsch-Bell/Tasca model if a burnout area of $1/10$ the junction area is assumed. Both the adiabatic term (At^{-1}) and the heat flow term (Bt/sup -½/) contribute in all devices, and the equilibrium term (C) contributes in some GaAsP devices. The scatter in the data for GaAs devices is greater than that for GaAsP devices, apparently because the former types have a significant fraction of mavericks with lower-than-normal thresholds. The use of LEDs to examine electrical pulse burnout is advantageous because the light output is quite sensitive to damage and the combined measurement of optical and electrical properties provides additional information about the mechanisms involved. (auth)

20376 TRANSIENT RESPONSE OF MOS CAPACITORS TO HIGH-ENERGY ELECTRON IRRADIATION. Snowden, D. P.; Flanagan, T. M. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2516-2521(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The response of Al-SiO_2-Si (n-type) MOS capacitors to pulsed 30-MeV electron irradiation has been investigated for both positive and negative bias on the field plate. For samples under positive bias, the charge-transfer signal consists of two components. The first is due to carrier pairs generated in the oxide, which are swept at sufficiently high applied oxide fields to the electrodes before they can be trapped or can recombine, and consequently saturates at high fields. This component has been previously observed for low-energy irradiation which essentially did not penetrate completely through the oxide. The second component is approximately linear in applied field and is interpreted as being due to electron injection from the silicon substrate. Under negative bias, for which the interface of the silicon substrate is inverted, an entirely different transient behavior is seen. A large charge-transfer signal is observed during a 1-mu sec irradiating pulse. The magnitude of the total charge transferred is independent of bias voltage for sufficiently large biases and has only a very weak dependence on dose. The source of this signal, which for 100-rad (Si) pulses is over an order of magnitude greater than that observed under positive bias conditions, has been shown to be due to motion of hole-electron pairs generated in the depletion region of the silicon. (auth)

20377 DEVICE DEGRADATION BY HIGH AMPLITUDE CURRENTS AND RESPONSE CHARACTERISTICS OF DISCRETE RESISTORS. Tasca, D. M. (General Electric Co., Valley Forge, PA); Wunsch, D. C.; Domingos, H. IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2522-2527(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

In designing or analyzing electronic circuits for nuclear radiation hardness it is important to know the response of components and their failure levels due to high level current pulses. Theoretical and experimental studies have been conducted on film, carbon composition and wirewound resistors to determine the power or voltage required to cause failure as a function of pulse width. Certain film resistors exhibit failure at the millijoule total energy level which is within the same energy range of concern for many semiconductor devices. Larger wattage carbon composition and wirewound resistors on the other hand were able to absorb tens of joules of energy without failure corresponding to tens of megawatts of power for 1 microsecond pulses. Simplified failure and response models are described. (auth)

20378 ELECTRICAL PULSE BURNOUT OF TRANSISTORS IN INTENSE IONIZING RADIATION. Hartman, E. F.; Evans, D. C. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2528-2532(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Tests examining possible synergistic effects of electrical pulses and ionizing radiation on transistors were performed and energy/power thresholds for transistor burnout determined. The effect of ionizing radiation on burnout thresholds was found to be minimal, indicating that electrical pulse testing in the absence of radiation produces burnout-threshold results which are applicable to IEMP studies. The conditions of ionized transistor junctions and radiation induced current surges at semiconductor device terminals are inherent in IEMP studies of electrical circuits. (auth)

20379 IONIZING EVENTS IN SMALL DEVICE STRUCTURES. Burke, E. A. (Air Force Cambridge Research Labs., Hanscom AFB, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2543-2548 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A theoretical model is described for calculating the number and average energy of ionizing events produced by x-rays in regions with characteristic dimensions ranging from mm to fractions of a mu m. Microdosimetry theory is applied to estimate the variance of the event distribution and it is found that when device dimensions are in the mu m range or less the distribution approaches lognormality. The model does not involve extensive calculations and uses only readily available data tabulations. It indicates that dose fluctuations could become significant if present trends towards smaller device elements continue. (auth)

20380 PACKAGING EFFECTS ON TRANSISTOR RADIATION RESPONSE. Berger, R. A.; Azarewicz, J. L. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2568-2572 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A procedure is established for determining the effective device radiation dose from the equivalent silicon ionizing dose as measured by a silicon calorimeter, provided the incident spectrum and device dimensions are known. Experimental data is obtained from a silicon transistor packaged in Kovar and Kovar/gold TO-5 cans and subjected to low- and high-energy photon radiation environments. The experimental results are compared to depth-dose profiles calculated by the SANDYL radiation transport code. The procedure correlates device photocurrent data between radiation environments with different photon energies. (auth)

20381 MEASUREMENT OF THE ENERGY DEPENDENCE OF NEUTRON DAMAGE IN SILICON DEVICES. Lohkamp, J. E.; McKenzie, J. M. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2319-2325(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

An experiment is described which measures the permanent degradation of silicon device parameters as a function of neutron energy. The neutron source is a nuclear weapon with time-of-flight giving energy resolution. The neutron spectrum is measured with a dielectric track detector, and 20,000 transistors measure the neutron caused degradation. An integral equation is unfolded to yield the energy dependence of neutron damage. (auth)

20382 TRANSVERSE SECTION EMISSION IMAGING. Brownell, G. L.; Chesler, D. A.; Burnham, C. A. (Massachusetts General Hospital, Boston). Trans. Am. Nucl. Soc.; 22: 112-113 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20383 STATE OF THE ART IN IEMP AND SGEMP CALCULATIONS. Longmire, C. L. (Mission Research Corp., Santa Barbara, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2340-2344(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The present state of calculational techniques for IEMP and SGEMP phenomena is reviewed, with emphasis on the physical, mathematical, and geometrical approximations made in various approaches. Some speculations are made on the ultimate capabilities of computer calculations, and the need for analytical calculations, especially simple methods for making estimates, is stressed. Finally, the possibly fruitful competition and complementation between digital (computer) and analogue (electrical simulation) techniques are discussed. (auth)

20384 SENSITIVITY OF SGEMP RESPONSE TO INPUT PARAMETERS. Wenaas, E. P.; Rogers, S.; Woods, A. J. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2362-2367(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Investigations into the sensitivity of SGEMP responses of simple geometries to various input parameters are made using the arbitrary body-of-revolution code ABORC. In particular, sensitivity of the response to emitted electron energy and angular distributions, emission levels, time dependence of the energy spectrum,

time-phasing, and the choice of emission surfaces are investigated. Sensitivity to time-phasing, the choice of emission surfaces, and the time dependence of the energy spectrum is found to be relatively large, while sensitivity to energy and angular distributions and total yield variations arising from differences between the various emission predictive techniques and experiments is found to be relatively small. Electron emission codes now in existence appear to be adequate for predicting SGEMP responses, at least in the energy range above 1 keV. (auth)

20385 MONODE PLASMA SHEATH DYNAMICS. Parks, D. E.; Wilson, A. R.; Katz, I. (Systems, Science and Software, La Jolla, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2368-2373 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

When a satellite is subjected to x-rays or uv radiation a space-charge sheath is created from the photoelectrons emitted from the surface of the spacecraft. An analytic treatment of the phenomenon is given and the results are compared with those obtained from computer calculations. (auth)

20386 SGEMP GEOMETRY EFFECTS. Woods, A. J.; Wenaas, E. P. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2374-2380(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Self-consistent, fully dynamic computer calculations were performed using the recently developed arbitrary body-of-revolution code ABORC for complex geometries in SGEMP environments to test the validity of simplifying geometry assumptions previously made in the solutions of these problems. Assumptions such as simple geometry representations of complex bodies and separability of inside and outside problems are tested. Effects of gaps, interior electrical paths, and booms protruding from bodies are discussed. High space-charge-limited results are emphasized. (auth)

20387 POTENTIALS AND CURRENTS INDUCED ON SATELLITES BY PROMPT PHOTON IRRADIATION. Rich, W. F.; Fisher, R. J. (Kaman Sciences Corp., Colorado Springs, CO). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2386-2391(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Fully self-consistent and Thevenin-equivalent treatments of a 1-d space charge limited diode connected to external circuitry have revealed that induced circuit currents resulting from the two different approaches are, in many respects, in good agreement with one another. Trial calculations were performed for frequently-encountered circuit component values and a wide range of fluences (from linear to very severely space charge limited regimes). Although additional exploratory work remains to be done, these results provide strong evidence for extensive applicability of the Thevenin-equivalent technique to coupling particle/field solutions of SGEMP problems external to a satellite to circuitry within that satellite. Results from a fully dynamic 2-d code are also presented as an illustration of the use of the Thevenin technique in analyses of real systems. (auth)

20388 HYBRID TECHNIQUE FOR SGEMP STRUCTURAL REPLACEMENT CURRENT CALCULATIONS. Higgins, D. F. (Mission Research Corp., Santa Barbara, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2397-2401(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Several methods for calculating the structural replacement currents generated by SGEMP are discussed. A hybrid method, combining a finite difference, particle-following approach in space with a circuit equivalent model for the spacecraft, is then developed, with emphasis on how the two techniques can be properly linked together. Some sample results using this technique are then given and compared with finite difference calculations. (auth)

20389 EFFECTS OF VARIOUS NON-CONDUCTING GAPS AND SURFACES ON SGEMP AND IEMP RESPONSE. Stettner, R. (Mission Research Corp., Santa Barbara, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2402-2407(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The usual treatment of electromagnetic fields generated when photoelectrons are ejected from satellite surfaces describes these fields as either external (SGEMP), when the sources are externally ejected electrons or internal (IEMP), when the sources are ejected internal to the satellite structure. In this paper the main thrust is to investigate the coupling to the interior from external sources. (auth)

20390 SIMULATING CABLE BUNDLE SGEMP EXCITATION: A THEORETICAL FEASIBILITY STUDY. Mangan, D. L. (Mission Research Corp., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2413-2419(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The feasibility of simulating SGEMP threat-related responses at the loads of multiwire satellite cables is theoretically examined. Two basically different threat-related modes of excitation are considered. One involves generic photon excitation, both non-attenuated (or uniform) and attenuated. The second involves generic electromagnetic field excitation, both nonpropagating (or uniform) and propagating. The simulation technique which is considered for the photon-related response is capacitance pipe excitation; the corresponding technique which is considered for the electromagnetic field-related response is toroid excitation. The investigation uses the time dependent solutions of the multiwire transmission line equations which are coupled with the appropriate definitions of the pertinent current and/or voltage source terms. (auth)

20391 SATELLITE SGEMP SURFACE CURRENT SIMULATION TECHNIQUES: A THEORETICAL INVESTIGATION. Mangan, D. L.; Perala, R. A. (Mission Research Corp., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2420-2427(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Various simulation techniques are examined which are considered feasible means to reproduce the external surface currents on satellite structures which result from system generated electromagnetic pulses (SGEMP). These techniques include (a) plane wave excitation, (b) monopole near-field excitation, (c) hardwire current injection excitation, and (d) charge injection excitation using a small self-contained pulser. The simulation effectiveness of each of these techniques, based on the ability of the simulation method to reproduce surface currents comparable to those predicted for generic SGEMP excitation, is explored. The conclusions from this investigation are: (1) the monopole excitation technique produces responses that simulate most favorably those predicted for the SGEMP excitation; (2) either current injection scheme will produce responses comparable to those predicted for local electron emission excitation provided the excitation scheme is sufficiently decoupled from the satellite; and (3) plane wave excitation produces responses that are significantly different, both in the peak magnitude variation around the satellite body and in the frequency content of the pulses, from those predicted for SGEMP. (auth)

20392 ELECTRICAL INJECTION SIMULATION OF SGEMP. Rosado, J. A. (Harry Diamond Labs., Adelphi, MD). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2428-2430(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Increasing attention has been given to the problem of predicting the response of satellites to the system-generated electromagnetic pulse (SGEMP). Results of the first SGEMP electrical injection simulation experiments on the SKYNET satellite are presented and compared them with pretest predictions. The important advantages offered by the electrical injection techniques are reviewed in light of the experimental findings. Latest advances in the state-of-the-art of injection pulsers, wide-bandwidth current probes and voltage probes, and dielectric transmission systems (dielectric waveguides and fiber optics) are high-lighted. The significance of the results lies in the conclusion that electrical simulation techniques may provide the satellite community with a non-destructive, believable test method for satellite verification. (auth)

20393 USING FERRITE BEADS AS AN SGEMP REDUCTION TOOL. Bloom, G. E. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2434-2439(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The basic attenuation properties of ferrite shielding beads are discussed in detail, as well as other important parameters and environmental considerations which might affect their usefulness in a SGEMP reduction application. Analytical techniques to predict insertion loss ratios in circuitry with beads are developed, and the effects of gapping and dc bias on the effective impedance levels presented by ferrite beads are examined. (auth)

Miscellaneous Instruments

Refer also to abstracts 20121, 21072, 21541, 21557, 21920, 21921, 22058, 22095, 22096, 22101, 22106, 22173, 22319, 22377, 22520–22540, 22542–22550, 22570, and 22583.

20394 (EUR-5370e) PROCEEDINGS OF 2ND ISPRA NUCLEAR ELECTRONICS SYMPOSIUM, STRESA, ITALY, MAY 20-23, 1975. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Jun 1975. 459p. (CONF-750521-P1).

Separate abstracts were prepared for 77 of the 85 papers for inclusion in NSA. Seven of the papers were not in scope and 1 paper was previously abstracted in NSA (32:06550). Six papers are abstracted in ERA. (WHK)

For abstracts of individual papers see: 19830, 19912, 20245–20265, 20291–20304, 20312–20319, 20395–20423, 20579, 21920, and 21921.

20395 (EUR-5370e, pp 67-69) CHANNEL PROFILES AND SMOOTHING IN CYCLING-SCALE ADC. Marino, D.; Mirizzi, N.; Stella, R.; Visaggio, G. (Univ., Bari, Italy). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A study of channel profiles and smoothing effect on spectral lines in cycling-scale AD converters is presented. (auth)

20396 (EUR-5370e, pp 85-86) ON-LINE PARTICLE SIZE ANALYZER USING CAMAC. Buschbeck, F.; Telefont, H. (Forschungszentrum, Seibersdorf, Austria). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

An electronic system to measure the diameter distribution of spherical high temperature reactor fuel particles was developed, the essential part of which is a specially designed CAMAC-module. The CAMAC-module described includes an amplifier, a peak hold circuit, a 12-bit buffered ADC, a brightness control as well as timing and LAM logic. (auth)

20397 (EUR-5370e, pp 95-97) THEORETICAL EXAMINATION OF A/D CONVERSION. Tarnay, K. (Central Research Inst. for Physics, Budapest). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A statistical model of analog-to-digital conversion is presented and discussed. (WHK)

20398 (EUR-5370e, pp 107-110) CONTRIBUTION TO ANALOGUE MULTIPLEXERS. Richard, A.; Leroux, J.; Engrand, M. (Institut de Physique Nucleaire, Orsay, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The analogue multiplexer, presented has up to 10 linear inputs to feed one A/D converter. Every input could be an independent channel or coupled with other inputs to form a correlated multichannel processing. The voltage drop of the stretched pulse is less than 1 mV/ms. The error caused by the duty cycle of the stretched signal is less than $2.5 \cdot 10^{-4}$. Performance data are given. (auth)

20399 (EUR-5370e, pp 229-232) SMOOTHING OF PHYSIOLOGICAL SIGNALS. JLISOI: Real-Time Parabolic Smoothing Module. Csakvary, E.; Mallier, G.; Roche, P. (CEN de Saclay, Gif-sur-Yvette, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Two applications of the module described are now under consideration: (1) spectra smoothing in nuclear physics, and (2) pre-processing of physiological signals. In particular in electrocardiography (haemodynamic laboratory, monitoring in intensive care units) parabolic smoothing by software is often used. (WHK)

20400 (EUR-5370e, pp 245-251) DEVELOPMENTS IN ARCHITECTURE FOR REAL-TIME DATA SYSTEMS. Heath, R. L.; Myers, W. R. (Aerojet Nuclear Co., Idaho Falls, ID). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Real-time data systems typically operate at two levels: a fast-response instrument-oriented level for data acquisition and control, and a slow human-oriented level for interaction and computation. Traditional minicomputer data systems support real-time applications by implementation of background/foreground software. Recent developments in computer technology including microprocessors enable the functional organization of hardware in distributed or hierarchical form to provide new system structures for real-time requirements. Examples of systems with distributed architecture are discussed in detail including a remote isotopic snow gage and remote isotopic monitoring with gamma-ray spectrometry. (auth)

20401 (EUR-5370e, pp 253-255) ZONE MEMORIES AND PSEUDORANDOM ADDRESSING. Marino, D.; Mirizzi, N.; Stella, R.; Visaggio, G. (Univ., Bari, Italy). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A quantitative comparison is presented between zone memories, pseudorandom addressed memories and an alternative special purpose memory ("spread zone" memory) in which the distance between any two transformed descriptors, at first adjacent, is independent of the descriptors pair and results in the maximum one. This memory has not been particularly considered at present in spite of its efficiency and its simple implementation. (auth)

20402 (EUR-5370e, pp 257-261) MECCA: MEGACHANNEL CAMAC ANALYZER. Tenten, W.; Reinhart, P.; Mueller, K. D. (Kernforschungsanlage, Juelich, Ger.). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A Mega Channel CAMAC Analyzer (MECCA) with 1,048,576 channels has been developed, using a magnetic drum as storage device. CAMAC instrumentation including a special purpose drum controller is used for interfacing to a PDP-11 computer. By combination of hardware and software techniques a data rate of 10^4 events per second is achieved. Buffer tape operation and off-line data processing can also be performed with this system. (auth)

20403 (EUR-5370e, pp 263-268) FAST STATISTICAL EVALUATION OF MULTICHANNEL SPECTRA USING THE WALSH TRANSFORM. Bastian, C. (EURATOM, Geel, Belg.). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Any counting spectrum of 2^n channels can be decomposed unequivocally into $n + 1$ independent contributions of progressively decreasing resolution scales. This decomposition is most simply performed on the Walsh transform of the spectrum. The ratio of the normative integral of each contribution to the level of the fluctuations is used to quantify the statistical relevance in terms of the resolution. An optimisation criterion allows to reduce the spectrum to a relevant number of broader channels covering the same range. Test analyses are presented. (auth)

20404 (EUR-5370e, pp 269-274) FAST DATA ACQUISITION PATH BASED ON A CAMAC MEMORY SYSTEM. Klesse, R.; Kostorz, G. (Institut Laue-Langevin, Grenoble, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

High data rates (up to 500 kHz) and the necessity of on-line data reduction lead to the development of a CAMAC based memory system. New MOS-technology (1 chip = 4096 bit) enabled us to make it reasonable in size (4 K words of 16 bit in $1/_{23}$ CAMAC-Module) and in price. On-line data reduction makes it possible to have on-line data acquisition (incrementation) with the minimum memory size. (auth)

20405 (EUR-5370e, pp 283-287) DOUBLE-CLIPPED DIGITAL CORRELATOR OPERATING IN REAL TIME AT 16 MHz. Corti, M.; De Agostini, A.; Degiorgio, V. (CISE, Milan). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A double-clipped digital correlator is described which works in real time up to a sampling frequency of 16 MHz and can perform correlation functions over 108 days. The instrument is specifically designed to measure intensity correlations of weak light beams but can also be used for the measurement of nuclear lifetimes and fluctuations in the reactor neutron flux. (auth)

20406 (EUR-5370e, pp 315-318) PROCESSING UNITS FOR SCIENTIFIC APPLICATIONS EMPLOYING INTEL 8008-I. Inguaggiato, B. (Montedel, Milan). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

This paper deals with a description of the applications of a unit employing a microprocessor INTEL 8008-I in the realization of scientific apparatus. The system that has been developed is also described and analyzed in its essential parts: CPU, interrupt logic, DMA logic, peripherals. (auth)

20407 (EUR-5370e, pp 319-323) IMPROVING AN EXISTING ACQUISITION SYSTEM BY MEANS OF A SMALL COMPUTER AND CAMAC. Volkov, P.; David, J.; Festa, E. (Institut de Physique Nucleaire, Orsay, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

There are many data acquisition systems in nuclear physics which exist for quite a long time and which are not as reliable and as versatile as they should be today. An example is given of how one could improve an existing data acquisition system

by simply introducing a small computer. The authors were urged to find an inexpensive solution in order to improve the reliability of their existing system; they used PDP 11/05 and a couple of CAMAC input-output units. (auth)

20408 (EUR-5370e, pp 325-331) APPLICATIONS AND DEVELOPMENT OF CAMAC IN NORTH AMERICA IN 1975. Mack, D. A.; Wagner, L. J. (Univ. of California, Berkeley). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
CAMAC is now a well established instrumentation system in North America. Research organizations outside of the National Laboratories and industrial users are finding that this modular instrumentation system for data handling is indeed a very practical and cost effective approach to Computer Aided Measurement And Control. Accordingly, applications of new developments in CAMAC during the past year are reviewed and its future is considered in view of related technological developments. (auth)

20409 (EUR-5370e, pp 333-335) POWERFUL METHOD FOR CAMAC DEMAND HANDLING. Zarandi, E.; Hetthessy, J. (Inst. for Electric Power Research, Budapest). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A Branch Driver is considered which has been developed to the R10 process control minicomputer compatible with MITRA 15 produced by the licence of CII. The Branch Driver satisfies the requirements both of the EUR 4600 CAMAC specifications and the specifications of the programmed Input/Output channel /MINIBUS/ of the R10. In addition to the transfer and command functions defined by the EUR 4600 specifications the Branch Driver makes possible to carry out autonomous block transfer and hardware demand handling for partial identification of the interrupt source. At the same time it ensures a relatively continuous sequence of GL operations. Further, the automatic modification of the actual CNA address is elaborated. (auth)

20410 (EUR-5370e, pp 337-340) AUTONOMOUS CONTROLLER (JCAM 10) FOR CAMAC CRATE WITH 8080 (INTEL) MICROPROCESSOR. Gallice, P.; Mathis, M. (Services d'Electronique, Saclay, France). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
The CAMAC Crate autonomous controller JCAM-10 is designed around an INTEL 8080 microprocessor in association with a 5K RAM and 4K REPROM memory. The concept of the module is described, in which data transfers between CAMAC modules and the memory are optimized from software point of view as well as from execution time. In fact, the JCAM-10 is a microcomputer with a set of 1,000 peripheral units represented by the CAMAC modules commercially available. (auth)

20411 (EUR-5370e, pp 341-346) MICROPROCESSOR-BASED CAMAC DATA ACQUISITION AND PROCESSING SYSTEM. Coppo, N.; De Grandi, G.; Montagni, M.; Stanchi, L. (EURATOM, Ispra, Italy). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
The peculiar characteristics of an autonomous CAMAC system based on the use of an Intel 8080 microprocessor are described. The system memory for program store, scratch work and data acquisition is contained in the autonomous CAMAC controller. Memory can be accessed in DMA mode with 24-bit data utilizing three bytes with a unique address. Suitable 3-byte floating point mathematical subroutines have been developed for general use and in particular for the requirements of the system. Details on hardware and software of the system are illustrated together with a brief mention of the generalizations. (auth)

20412 (EUR-5370e, pp 347-348) FAST MULTIPROGRAMMABLE BRANCH DRIVER FOR MICRAL MINI-COMPUTER. Kaiser, J.; Lacroix, J. (Services d'Electronique, Saclay, France). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
This branch driver allows in association with the stack memories of the minicomputer Micral, very fast exchanges with the 7 crates of a CAMAC branch. A CAMAC program (read, write and control commands) is loaded in the IK stack memory of the Micral and executed in sequence at a rate of 1.6 μs per CAMAC command. After program execution, data may be transferred directly on a magnetic tape. (auth)

20413 (EUR-5370e, pp 355-357) CAMAC PROBLEMS IN AUTOMATION AT THE INSTITUTE OF RADIOELECTRONICS OF WARSAW TECHNICAL UNIVERSITY. Piatkowski, A.; Brzeski, P.; Jamrogiewicz, T.; Kazubek, M.; Mirkowski, J.; Modzelewski, A.; Pawlowski, M.; Wroblewski, M. (Technical Univ., Warsaw). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
The paper gives short information on the CAMAC System worked out in the Institute of Radioelectronics to automatize the measurements in the nuclear laboratory. The System was elaborated for collaboration with a minicomputer. Some information on the software possibilities of the System is also given. (auth)

20414 (EUR-5370e, pp 369-371) CAMAC SYSTEM ORGANIZATION FOR A READOUT FROM VARIOUS GROUPS OF MODULES. Churin, I. N.; Petrov, A. G.; Sidorov, V. T.; Sinaev, A. N.; Zhuravlev, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A CAMAC system for a readout from various groups of modules is described. The system is based on a read-only controller and a special LAM grader. According to arriving L signals and their patching in the LAM-grader, signals for the following operations can be generated; a readout in the address scan mode, a block transfer from one address (using the BQL-mode), disabling the readout from some groups of stations and ending the readout. The system is very flexible and may consist of both one and several crates. (auth)

20415 (EUR-5370e, pp 373-375) CAMAC MULTIPARAMETER UNIT AND ITS USE TOGETHER WITH ADC'S AND A FAST COINCIDENCE PATTERN UNIT. Hoy-Christensen, P. (Univ. of Copenhagen). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A modular data collection system in CAMAC for coincidence as well as single events is described. The system contains a specially designed coincidence unit, which is explained in detail. One specific application is also shown using a fast coincidence pattern unit, designed for use in a multiplicity experiment.

20416 (EUR-5370e, pp 377-380) COMPUTER CONTROLLED MULTICHANNEL ANALYZER USING A CAMAC ADC. Prior, G. M.; Peel, T. D. (Nuclear Enterprises, Beenhan, Eng.). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
A multichannel analyzer system has been developed, based on a PDP 11/05 computer interfaced to CAMAC. The system is highly adaptable because control is effected through software, whilst the CAMAC interface offers optional functions by plug-in modules. The system is thus suitable for many applications, some of which, now in use, are briefly mentioned below. Whilst the original system used a NIMS based ADC, a single width CAMAC ADC has now been developed, so that all the interfacing is by CAMAC modules. Simplicity of control and increased data throughput whilst reducing costs were thus achieved. The unknown factor in using analogue circuitry in a CAMAC crate is the possible degradation of the inherent specification by the noisy electronic environment. Minimizing these effects was an important part of the development and in the production tests the noise figure and differential linearity are tested by computer to ensure that the specification is maintained. (auth)

20417 (EUR-5370e, pp 397-405) TOWARD PICOSECOND RESOLUTION. Contribution of Microchannel Electron Multipliers to Vacuum Tube Design. Pietri, G. (Laboratoires d'Electronique et de Physique Applique, Limeil-Brevannes, France). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
LEP research in the field of wide band, high speed vacuum electron devices is reviewed. Activities in the areas of photoelectric transducers, photoelectric converters, and wide-band CRT for high speed oscilloscopy are discussed. (WHK)

20418 (EUR-5370e, pp 411-414) GIGAHERTZ SAMPLING TRANSIENT ANALYZER. Andrieu, F. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France); Balanca, C.; Bernet, J. M.; Lejeune, G. Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In proceedings of 2nd Ispra nuclear electronics symposium.
The AN 800 equipment was designed in connection with the French Atomic Energy Commission (CEA) for the purpose of digital conversion of fast signals. The CEA requirements were: recording of a single signal; signal rise-time bracket: from a few nanoseconds to a few microseconds; dynamic range: more than 80 dB; and accuracy: 1%. Due to the remote location of the sensor and problems in handling this signal on long transmission lines, the recording device had to be located close to the sensor. Therefore, the equipment had to be highly reliable and had to

transmit its output signals before an electromagnetic pulse disturbance. A schematic is given. (WHK)

20419 (EUR-5370e, pp 415-420) PERFORMANCE OF AN ULTRA-FAST OSCILLOSCOPE-PHOTOCELL DETECTION SYSTEM (5 GHz). Analysis of Subnanosecond Fluorescence Decay Curves. Cunin, B.; Heisel, F.; Knispel, G.; Miehe, J. A.; Sipp, B. (Univ. Strasbourg). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The use of a microchannel electron multiplier embedded near the phosphor screen of a broadband cathode ray-tube leads to several important improvements: (i) high vertical sensitivity (100 mV per 0.7 cm) (ii) fast writing speed allowing a sweep rate as high as 100 ps per 0.7 cm (iii) intense brightness of the trace on the screen: single shot measurements can be observed in the surrounding room light. The intrinsic time resolution of the oscilloscope-diode combination (FWHM 120 ps) makes the device very suitable to study the luminescence decay laws of substances having emitting levels with lifetimes as short as 100 ps or generated by fast reactions producing a finite rise time. The high amplitude sensitivity of the dispositif allows measurements of fluorescence decay curves of substances with quantum yield as low as 2‰ (tetracene). (auth)

20420 (EUR-5370e, pp 429-437) SURVEY ON THE MOST RELEVANT ELECTRONIC PAPERS PRESENTED AT THE 1ST INTERNATIONAL CONFERENCE OF THE IRAQI ATOMIC ENERGY COMMISSION. Al-Kayssi, B. (Nuclear Research Inst., Baghdad). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

At the first Scientific Conference of the IRAQI Atomic Energy Commission, two sessions were specifically devoted to Electronics. Some more information, which is considered interesting for the present survey has been derived from other scientific sessions. The papers presented in the electronic field can be grouped into four categories, namely (1) CAMAC and computer applications; (2) analogue processing; (3) device fabrication; and (4) scientific instrumentation development. It is the purpose of this review to report about the essential results and considerations that emerged from the presentation of the papers as well as from discussions. (auth)

20421 (EUR-5370e, pp 439-440) REAL TIME OSCILLOSCOPE AND PHOTODETECTOR DEVICE WITH PICOSECOND RESOLUTION. Loty, C. (Laboratoire d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The measurement of very fast optical signals is presently done with two types of apparatus: a photodetector and oscilloscope chain, or a streaking camera. Apparently the second system is much more performant than the first. The streaking camera associated to a brightness intensifier is able to display picosecond resolution, being limited only by the transit time dispersion of the photoelectrons. The oscilloscopic device on the other hand seems to be limited in the range of several hundred picoseconds. We might question what in the physics implied in those two apparatus is responsible for such a difference, and which part is due to technological details. It is attempted to answer this double question and a possible oscilloscopic device with picosecond real time resolution is presented. (auth)

20422 (EUR-5370e, pp 441-446) HIGH RESOLUTION, LARGE DYNAMIC RANGE TIME INTERVAL METERS. Andrieux, F. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France); Assadoullah, A.; d'Humieres, E.; Trabaud, R. Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

Circuits and specifications for some high-precision time interval analyzers are given and discussed. (WHK)

20423 (EUR-5370e, pp 459) VECTOR-CAMAC PICOSECOND TIME INTERVAL ANALYZERS AND SPECTROMETERS. Kurochkin, S. S.; Pankratov, V. M.; Rechin, E. I.; Chernov, P. S. (Union Scientific Research Inst. of Instruments, Moscow). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

A set of units for time interval analyzers and spectrometers with 50 picosecond resolution is designed. Total resolution of analyzers and spectrometers is ~100 picoseconds, differential non-linearity is <1%. The analyzers and spectrometer are packaged into VECTOR-CAMAC units. (auth)

20424 (EUR-5370e) PROCEEDINGS OF 2ND ISPRA NUCLEAR ELECTRONICS SYMPOSIUM, STRESA, ITALY, MAY 20-23, 1975. Round Table Discussions. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Jun 1975. 60p. (CONF-750521-P2).

Summaries of the round table discussion on microprocessors and minicomputer balance for nuclear, biomedical, and environmental measurements and the round table discussion on extension of nuclear techniques to other fields are presented. (WHK)

20425 (TID-26978) RADIO-FREQUENCY INDUCTION FOR CHECKING FIRE DETECTORS. Aarts, H. J.; Evans, W. B.; Utley, L. W. (Atomics International Div., Golden, Colo. (USA)). 22 Jan 1976. Contract E(29-2)-3533. 10p. Dep. NTIS $3.50.

A new method of testing fire detectors in the glove-box lines has been developed. The method includes heating the fire detector by a strong electromagnetic field which induces eddy currents in the metal case of the fire detector. Developed as a radio-frequency induction heating system, a prototype was designed and built for use with fire detectors installed at the Rocky Flats Plant. The system has been tested and operates satisfactorily. It is concluded that the system could be installed in glove boxes and could easily be automated from a central point. Applications exist for glove-box lines on site or for facilities off site. (auth)

20426 STABLE ISOTOPE RATIOMETER—MULTIPLE ION DETECTOR UNIT FOR QUANTITATIVE AND QUALITATIVE STABLE ISOTOPE STUDIES BY GAS CHROMATOGRAPHY—MASS SPECTROMETRY. Klein, P. D.; Haumann, J. R.; Hachey, D. L. (Argonne National Lab., IL). Clin. Chem.; 21: No. 9, 1253-1257(Aug 1975).

From 7th annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975). See CONF-750319-.

A stable isotope ratiometer–multiple ion detector unit, which can drive existing gas chromatograph-quadrupole or magnetic sector mass spectrometers to monitor up to six ions in turn, is described. Each of the three pairs of ions can be selected for quantitation; thus three different or successive components can be analyzed in a single gas-chromatographic run. A background subtraction option permits the ion intensity in the absence of sample to be subtracted automatically during sample measurement. Displays of accumulated counts and isotope ratio are updated twice per second during the measurement and can be printed out at its conclusion. All six ions can be monitored in the analog mode by parallel outputs to a multipen recorder. Experience gained in the construction of this prototype indicates that such units could be commercially available for $10,000, or about a third to a sixth of the cost of even an inexpensive computer system. (auth)

20427 MATHEMATICAL MODEL OF AN INDUCTIVE TYPE SODIUM LEVEL METER AND SOME APPLICATIONS. Asano, K. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2689-2695(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A mathematical model of an inductive type liquid sodium level meter has been developed, which simulates behavior of the level meter in various environmental conditions. A test model was made to confirm experimentally the accuracy of the mathematical model. It was recognized that the mathematical model shows fairly well the behavior of an actual level meter. Error estimations were accomplished with this mathematical model. Errors are caused by the change of ambient temperature and by the surface tension of sodium. (auth)

20428 DIGITAL COMPUTER IN NUCLEAR MEDICINE: WHERE DO WE STAND. Maskewitz, B. F.; McClain, W. J.; Henne, R. L. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 124-125(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20429 IMPROVED ELECTROCHEMICAL CELL FOR MEASURING OXYGEN IN LIQUID SODIUM. Roy, P. (General Electric Co., San Jose, CA). Trans. Am. Nucl. Soc.; 22: 220-221(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

20430 INTRODUCTION TO TRITIUM TECHNOLOGY. Meyer, L. H. (E. I. DuPont de Nemours and Co., Aiken, SC). Trans. Am. Nucl. Soc.; 22: 736(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Isotope Separation (Industrial)

Refer also to abstract 20720.

20431 (CONF-750117-P1, pp 135-234) FUEL CYCLES FOR NUCLEAR REACTORS: URANIUM ENRICHMENT AND REPROCESSING. Benedict, M. (Massachusetts Inst. of Tech., Cambridge). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

Fuel cycle requirements and flowsheets are given for pressurized water reactors, high temperature gas cooled reactors, and heavy water reactors. Gaseous diffusion, gas centrifugation, separation nozzle methods, and laser methods are discussed as means of enriching uranium. The Purex and Thorex processes of reprocessing spent fuel are covered. (LK)

20432 (CONF-751134-) URANIUM ENRICHMENT CONFERENCE, OAK RIDGE, TENNESSEE, NOVEMBER 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office). 1975. 116p. Dep. NTIS $5.50.

Eight papers were presented. Each has been abstracted and indexed separately. (JGB)

For abstracts of individual papers see: 20433–20440.

20433 (CONF-751134-, pp 1-6) REVIEW OF FY 1975 OPERATIONS. Sullivan, E. R. Jr. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office).

Gaseous diffusion plant operations for fiscal year 1975 are emphasized, with consideration to fiscal year 1976 and the long-term picture. The effects of the increased and reduced supply of power on production of enriched uranium are evaluated. (JGB)

20434 (CONF-751134-, pp 7-16) RESULTS OF EXPANDED CONTRACT OFFER. Huffman, F. C. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office).

Recent delays and cancellations of reactor projects have reduced the utilities' needs for previously contracted enriched uranium. As a result requests were made to US-ERDA for renegotiation of long-term fixed-commitment contracts. Contractors were given the option of reducing or canceling their original commitments; 193 out of 247 contract holders desired to make some change in their contracts. Summaries of contract modifications are tabulated. (JGB)

20435 (CONF-751134-, pp 17-26) ERDA GASEOUS DIFFUSION PLANTS OPERATIONAL CONSIDERATIONS. Thomas, D. C. (Energy Research and Development Administration, Washington, DC). 1975.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office).

Factors that determine enrichment plant tails assay and directly affect US-ERDA's commitments to supply enriched uranium are discussed. Two options that would permit a customer to avoid possible future high tails assays are suggested. (JGB)

20436 (CONF-751134-, pp 27-40) ALTERNATE ERDA OPERATING PLANS. Parks, J. W. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office).

Variables associated with the operation of a gaseous diffusion facility are discussed. Particular emphasis is placed on the probability of power reactor recycling of Pu, an increase in transaction tails assay in the gaseous diffusion process, and the availability of electric power. Four alternate operating plans are summarized. (JGB)

20437 (CONF-751134-, pp 41-55) URANIUM REQUIREMENTS AND SUPPLY OUTLOOK. Patterson, J. A. (Energy Research and Development Administration, Washington, DC). 1975.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office).

The effects of recent rescheduling of US-ERDA's contract commitments for enriched uranium on uranium requirements for the various enrichment plant operating plans are reviewed. Procurement arrangements for U are examined, and the capability of the domestic industry in meeting these needs as well as the possible use of foreign U are considered. (JGB)

20438 (CONF-751134-, pp 57-66) BUILDUP OF ^{236}U IN THE GASEOUS DIFFUSION PLANT PRODUCT. Ford, J. S. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office).

A generalized projection of the average annual ^{236}U concentration that can be expected in future enriched uranium product from the US-ERDA gaseous diffusion plants when reprocessed fuels become available for cascade feeding is given. It is concluded that the buildup of ^{236}U is not an ever-increasing function, but approaches a limiting value. Projected concentrations result in only slight separative work losses and present no operational problem to ERDA in supplying light water reactor requirements. The use of recycle uranium from power reactor spent fuels will result in significant savings in natural uranium feed. (JGB)

20439 (CONF-751134-, pp 67-92) GASEOUS DIFFUSION OPERATIONS. Sommerfield, K. W. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office).

Steps involved in the gaseous diffusion process for enriching uranium are discussed. Operating experience of facilities at Paducah, Oak Ridge, and Portsmouth is outlined. (JGB)

20440 (CONF-751134-, pp 93-106) STATUS REPORT ON CIP/CUP PROGRESS. Larkin, W. J. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Nuclear Fuel Cycle

and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office).

Work on the Cascade Improvement Program (CIP) and the Cascade Uprating Program (CUP) continues basically on schedule. When completed the productive capability of the gaseous diffusion facilities at Paducah, Oak Ridge, and Portsmouth will be increased by 60 percent. (JGB)

20441 (UCRL-Trans-10741) USE OF LIGHT PRESSURE FOR SELECTIVE PUMPING OF GASES. Usikov, A. Ya.; Kontorovich, V. N.; Kaner, E. A.; Blokh, P. V. Translated from Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 8, 1245-1248(1972). 11p. Dep. NTIS $3.50.

It is shown that light pressure can be used as a pump. The "light pump" exhibits a certain selectivity due to the resonance nature of light absorption in gases. The possibilities of selective pumping in gas mixtures and of the separation of isotopes are discussed. Estimates indicate the feasibility of the light pump design when modern lasers are used. (auth)

20442 USE OF PLASMA INSTABILITIES IN LASER ISOTOPE SEPARATION. Book, D.L. (Naval Research Laboratory, Washington, D. C. 20375). J. Appl. Phys. 47: No. 1, 200-203 (Jan 1976).

A design is sketched for a continuously operating device which separates one laser-excited isotopic species of a given element from a mixture. The essential innovation is the use of collisionless plasma instabilities to slow down ions of the desired species from two counterstreaming initially neutral beams. (auth)

20443 URANIUM ENRICHMENT: WHAT IT MEANS AND WHAT IS INVOLVED. Liddy, J. C. Aust. Min.; 67: No. 5, 13-17(May 1975).

The economics and demand for uranium enrichment are discussed. A brief description is given of the various methods of isotope separation including gaseous diffusion, centrifugation and the nozzle separation method. (AUS)

20444 ENRICHMENT: THE CURRENT STATUS AT OAK RIDGE, PORTSMOUTH, AND PADUCAH. Wilcox, W. J. Jr.; Bradbury, J. T. (Union Carbide Corp., Oak Ridge, TN). Trans. Am. Nucl. Soc.; 22: 309(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20445 URANIUM ENRICHMENT ASSOCIATES GASEOUS DIFFUSION PLANT: PROGRESS AND OUTLOOK. O'Donnell, A. J. (Uranium Enrichment Associates, San Francisco). Trans. Am. Nucl. Soc.; 22: 309-310(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20446 SOME CHARACTERISTICS OF THE UEA GASEOUS DIFFUSION PLANT. Garrett, G. A.; Reti, G. R. (Bechtel Corp., San Francisco). Trans. Am. Nucl. Soc.; 22: 310(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20447 EXXON NUCLEAR COMPANY, INC. CENTRIFUGE ENRICHMENT PROGRAM. Astley, E. R.; Dahlen, D. M. (Exxon Nuclear Co., Inc., Bellevue, WA). Trans. Am. Nucl. Soc.; 22: 310-311(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20448 TECHNICAL AND ECONOMIC FEASIBILITY OF CENTRIFUGE ENRICHMENT PLANTS. Pirro, J. (Burns and Row Industrial Services Corp., Paramus, NJ). Trans. Am. Nucl. Soc.; 22: 311-312(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20449 PROSPECTS FOR URANIUM LASER ISOTOPE SEPARATION. Forsen, H. K. (Exxon Nuclear Co., Bellevue, WA); Janes, G. S.; Levy, R. H. Trans. Am. Nucl. Soc.; 22: 312-313(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20450 URANIUM ENRICHMENT BY SEPARATION NOZZLE PROCESS. Becker, E. W.; Bier, W.; Ehrfeld, W.; Schubert, K.; Schuette, R.; Seidel, D. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Trans. Am. Nucl. Soc.; 22: 313-314(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20451 DESIGN CONSIDERATIONS FOR AN ULTRA-CENTRIFUGE ENRICHMENT PLANT. Walrave, W. K. A. (Comprimo, Amsterdam). Trans. Am. Nucl. Soc.; 22: 314(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Isotopic Power Sources

20452 (BNWL-1845-18) PACIFIC NORTHWEST LABORATORY MONTHLY REPORT TO ADVANCED NUCLEAR ENERGY SYSTEMS, SPACE AND SPECIAL PURPOSES DIVISION FOR NOVEMBER 1975. Fullman, H. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-1830. 8p. Dep. NTIS $4.50.

At Hanford, strontium will be separated from the high-level waste, then converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). This encapsulated strontium fluoride represents an economical source of ^{90}Sr if the WESF capsule can be licensed for heat source applications under anticipated use conditions. The objectives of this program are to obtain the data needed to license $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF_2$ capsules. The information needed for licensing can be divided into three general areas: long-term SrF_2 compatibility data; chemical and physical property data on $^{90}SrF_2$; and capsule property data such as external corrosion resistance, crush strength, etc. The current program is designed to provide the required information. (auth)

20453 (DPST-72-128-2) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Oct 1972. Contract AT(07-2)-1. 10p. Dep. NTIS $3.50.

Progress during October 1972 in the Savannah River Laboratory ^{238}Pu Fuel Form Program is reported. This program is designed to provide technical information for the transfer of ^{238}Pu fuel for fabrication operations from Mound Laboratories to a new facility of SRL with startup in January 1976. Information is included on selection of process for obtaining PuO_2 feed powder; results of direct-strike precipitation of 20 plant batches of ^{238}Pu oxalate and conversion to large-particle $^{238}PuO_2$; preliminary discussion of facility design and facility safety analysis; scrap recovery operations; and documentation issued. (LCL)

20454 (DPST-72-128-3) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Nov 1972. Contract AT(07-2)-1. 20p. Dep. NTIS $3.50.

The familiarization phase of the SRL program is largely completed. The technical basis for the design of the production facility has been established. Detailed requirements for the production hot press have been developed and preliminary design specifications have been issued. Centorr Associates has been retained by the Engineering Department to prepare the detailed design. In the molybdenum coating process, better control on the amount of molybdenum deposited on the $^{238}PuO_2$ shards and elimination of the reaction of chlorine with the $^{238}PuO_2$ would be desirable. Equipment to investigate these areas at SRL is under construction. Approximately 1.5 kg of $^{238}PuO_2$ made by the direct-strike oxalate process was shipped to LASL early in November. Evaluation of image analysis equipment was completed and a vendor selected. Project authorization to purchase this equipment is expected in February. A facility for testing the performance of the production hot press and the fabrication of prototype fuel forms for quality certification will be installed in Building 235-F. Design of the facility for project authorization has been started. (auth)

20455 (DPST-72-128-4) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Dec 1972. Contract AT(07-2)-1. 19p. Dep. NTIS $3.50.

Detailed flow sheets for potential plant products (PMC and PPO) were issued to the Manufacturing Division. A preliminary description of techniques for metallographic inspection for the plant facility, including a description of equipment required and specific examinations to be made, was issued to the Manufacturing Division. About 750 gms of ^{238}Pu scrap were charged to the recovery operation. Problems with filter pluggage, from various causes, were solved by an alteration to the wash procedure. (auth)

20456 (DPST-73-128-5) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). May 1973. Contract AT(07-2)-1. 23p. Dep. NTIS $3.50.

Intermediate sized (~10 μ) $^{238}PuO_2$ can be produced reproducibly with <5% fines (<4 μ) by control of mixing action and oxalate addition rate during direct-strike precipitation. Precipitation of Pu^{+4} rather than Pu^{+3} offers no advantage. A solid Ascarite/D Drierite scrubber can be used to collect HCl from the molybdenum coating operations during PMC production to avoid handling liquid waste from liquid HCl scrubbers in Building 235-F. Definitive assumptions were made of the scope of the PuFF Facility for disassembly and recovery of ^{238}Pu RTG's. (auth)

20457 (DPST-73-128-7) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Contract AT(07-2)-1. 16p. Dep. NTIS $3.50.

The extension to the Alpha Materials Facility is now operational using maximum quantities of 5 g ^{238}Pu. Work with larger quantities will begin on completion of the automatic fire suppression system and ventilation modifications. Observation of grain boundary porosity caused by release of stored helium on heating to 1200 and 1600°C in dense $^{238}PuO_2$ shards about 11 mo after fabrication indicates that the size of grain boundary pores increases progressively with annealing temperature between 1000 and 1600°C. BET surface area analyses of krypton adsorption on 9-μ direct-strike $^{238}PuO_2$ were reproducible on repetitive analyses with the same 300-mg samples, but gave significantly different results on different samples from the same powder lot. Based on economic and design considerations and on thermodynamic analyses, the maximum nitrogen concentration in the recirculating argon atmosphere of the PuFF Facility will be set at 1000 ppm. Operation of the chemical vapor deposition (CVD) system was evaluated further using 4% H_2–96% He. However, because of decreased funding, further development on PMC process development has been postponed until FY-75. (auth)

20458 (DPST-73-128-8) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Aug 1973. Contract AT(07-2)-1. 28p. Dep. NTIS $4.00.

A preliminary accident analysis for the PuFF Facility has been drafted and is under review. Aged shards, fired initially at 1200°C and intended for PPO production, show evidence of microstructural damage because of release of decay helium when heated to hot-pressing temperature. The low thermal conductivity of $^{238}PuO_2$ and the necessity to keep powder temperatures low to prevent sintering have been shown to significantly limit the batch size and storage and processing configurations for $^{238}PuO_2$ in the PuFF Facility. Because of budgetary and program requirements, process development and demonstration on PMC will be deferred; the capability to produce PMC fuel in the PuFF Facility may be delayed beyond startup. The SRL effort in support of the Milliwatt RTG will be limited to support of Sandia-Albuquerque and MRC in characterizing the $^{238}PuO_2$ powder shipped to MRC to assure satisfactory feed for fuel form production at MRC.

20459 (DPST-73-128-9) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Sep 1973. Contract AT(07-2)-1. 38p. Dep. NTIS $4.00.

Microstructural damage to dense $^{238}PuO_2$ fuel caused by release of decay helium is not removed by annealing after helium removal. Additional calculations of the temperatures of $^{238}PuO_2$ in storage and process are presented. Up to 500 ppm hydrogen can be tolerated in the argon atmosphere of the process cells without significant effect on the quality of the $^{238}PuO_2$ fuel or operational equipment. The hydrogen may be introduced during oxygen removal operations in the argon recirculation system. The scope of the PuFF Facility was expanded to include primary encapsulation of PPO spheres in iridium. Initial assessment of potentially severe occurrences of extremely low frequency show that the PuFF Facility when completed will conform to the Minimum Design Criteria for new Plutonium Facilities. The variance in cationic impurity levels in SRP $^{238}PuO_2$ production over the last four years is presented. (auth)

20460 (DPST-73-128-10) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Oct 1973. Contract AT(07-2)-1. 29p. Dep. NTIS $4.00.

The pressure drop through $^{238}PuO_2$ powder beds is relatively small and should not affect the design of production equipment for oxygen-16 exchange. Pour and tap densities of $^{238}PuO_2$ feed, milled, and shard powders are reported. Small-scale milling, shard fabrication, and hot pressing experiments have begun in the Alpha Materials Facility. Helium damage in $^{238}PuO_2$ shards is not significantly healed by heating at fuel operating temperatures. Preliminary recommendations were made on primary encapsulation of pure plutonium oxide in the ^{238}Pu Fuel Fabrication Facility. One hundred thirty grams of high-purity $^{238}PuO_2$ has been sent to Monsanto Research Corporation in support of the Milliwatt RTG program. (auth)

20461 (DPST-73-128-11) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Nov 1973. Contract AT(07-2)-1. 34p. Dep. NTIS $4.00.

The microstructure and sinterability of LASL PPO shards were investigated. After calibrating the mini-hot-press, a $^{238}PuO_2$ pellet was pressed to 80% density using heat-treated shards. Automatic pressing cycles of the production hot press are described. The scope is described for disassembly operations to recover ^{238}Pu from retired or damaged capsules and generators. The process is described to prepare 200 g of direct-strike $^{238}PuO_2$ for tests at MRC as part of the Milliwatt RTG program. The new metallograph and scanning electron microscope were received. (auth)

20462 (DPST-73-128-12) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Dec 1973. Contract AT(07-2)-1. 26p. Dep. NTIS $4.00.

Tap and pour densities ranged from 1.5 to 5.1 g/cc for calcined, reverse-strike feed and sintered PMC shards, respectively. Densities of shards increased with increasing particle size and increasing sintering temperature; densities for milled powder are higher than for calcined, reverse-strike powder, indicating a strong effect of particle shape that is removed by milling. Vibratory milling calcined, reverse-strike oxide for 8 h produced the same size distribution as a ball milling at LASL for 32 h. Milling is postulated to reduce low-density aggregates to high-density platelets without changing specific surface area significantly. Post-hot-pressing heat treatment has a small effect on pellet dimensions and weight. The slight weight increase is probably due to oxidation of the suboxide. Air sampling stations between filter stages in exhausts from the AMF show ^{238}Pu concentrations that are only 10^{-2} to 10^{-3} times the expected values. (auth)

20463 (DPST-74-128-1) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jan 1974. Contract AT(07-2)-1. 22p. Dep. NTIS $3.50.

SNS has advised that plans for production in the PuFF Facility include a production requirement of 15 kg as PPO for the last half of FY-76. The thermal conductivity of reverse-strike $^{238}PuO_2$ powder was measured in air and argon. Bed thicknesses for $^{238}PuO_2$ powder arrays were calculated and specified to control process temperatures. The schedule of the full-scale experimental facilities has been revised. Initial operations with ^{238}Pu is forecast for March 1975, with hot pressing to begin in May 1975 or later, depending on the date of availability of FY-1975 capital funds. (auth)

20464 (DPST-75-128-11) ^{238}Pu FUEL FORM PROCESSES. Savannah River Laboratory Monthly Report. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Nov 1975. Contract AT(07-2)-1. 47p. Dep. NTIS $4.00.

The equation relating the mode size of calcined $^{238}PuO_2$ powder to precipitation variables has been revised with the addition of more data and is now applicable over a broader range of precipitation conditions. Characterization of samples received from Los Alamos Scientific Laboratory (LASL) indicates that oxygen exchange and outgassing have little effect on particle size and tap density, and show that the powder is incompletely milled after 32 hours of ball milling. A correlation between the mass median particle size of milled powder and final pellet density indicates that variations in milled particle sizes may be directly responsible for the variations in fabricability. Thermal gradients due to self-heat of $^{238}PuO_2$ have been calculated for oxalate calcination operations in H-Area B-Line and for feed preparation operations in the Plutonium Fuel Form Facility (PuFF). Gradients of less than 50°C are expected in each of the feed preparation steps; however, smaller loads or redesigned crucibles will be necessary to reduce the thermal gradient to less than 200°C during calcinations. The helium release from $^{238}PuO_2$ pellets of 90 percent theoretical density that were heated after 18 months storage caused pronounced grain boundary separation. Design of the Plutonium Experimental Facility is 95 percent complete, and construction is 31 percent complete. (auth)

20465 (DPST-75-128-12) ^{238}Pu FUEL FORM PROCESSES. Savannah River Laboratory Monthly Report. (Du Pont de Nemours

(E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Dec 1975. Contract AT(07-2)-1. 30p. Dep. NTIS $4.00.

An equation relating precipitation parameters with agglomeration has been established which can predict the agglomeration index to +-5 wt percent. The solubility of Pu(III) oxalate was measured as a function of temperature, nitric acid concentration, and oxalic acid concentration. The decontamination factors (DF's) for individual impurities during precipitation are being determined. Preliminary data show a DF of two for aluminum and iron. The concentration of calcium increased tenfold. The concentrations of other cations did not change (except possibly for lead). Dependence of grain boundary helium bubble formation on the grain size and concurrently varying porosity of $^{238}PuO_2$ shards was further defined. Critical grain sizes, above which gas bubbles were formed, decreased with increasing temperature. (auth)

20466 (IFA-FR-138-1975) USE OF A CONVERTED MAGNETRON FOR MAKING ELECTRIC GENERATORS WITH RADIOISOTOPES OR A CONVERTING CELL OF THE FISSION NUCLEAR ENERGY. Cristea, G.; Fratiloiu, G. (Institutul de Fizica Atomica, Bucharest (Romania)). Jun 1975. 15p. Dep. NTIS (US Sales Only) $3.50.

In this paper the working principle of a magnetron is examined from the standpoint of the accomplishing of the necessary transformation of this device. The principle of the electric generator with radioisotopes as well as of the converting cell of the fission nuclear energy using a modified magnetron is explained. Both the electric generator with radioisotopes and the converting cell of the fission nuclear energy represent energy sources supplied in the form of micro-waves – the main power source -and of direct current – the secondary reduced power source. (auth)

20467 (LA-6013) ISOTOPE FUELS IMPACT TESTER (IFIT). Frantz, C. E.; Taylor, J. W.; Court, D. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-Eng-36. 22p. Dep. NTIS $4.50.

The Isotope Fuels Impact Tester (IFIT) is used for safely impacting $^{238}PuO_2$ heat sources that have been heated to 2000°C. Impact velocities reach 300 m/s (1000 ft/s). A gas gun with a 178-mm (7-in.) bore is used to accelerate the heat source, which is heated by a furnace built into the projectile. Double containment of the impacted heat source is obtained by two vessels that are sealed directly to the gun muzzle. The impact occurs in the inner vessel, and parts of the projectile jam into and thereby close each vessel. The inner vessel, containing the impacted heat source, is removed from the gun and is placed inside a glovebox for disassembly and heat-source recovery. IFIT's modular structure makes it versatile and adaptable to many types of tests. Many applications have demonstrated its versatility and, more important, its capability for impacting $^{238}PuO_2$ heat sources safely. An approximate theoretical relation is used to predict proper conditions for achieving desired impact velocities. Bore lubricants and projectile-seal design are also important for achieving proper impact velocities. (auth)

20468 PLUTONIUM RELEASE RATES FROM ^{238}Pu FUELS EXPOSED TO AQUATIC ENVIRONMENTS. Matlack, G. M.; Patterson, J. H.; Nelson, G. B.; Waterbury, G. R. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 100-101(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20469 COLD REGIONS ISOTOPE APPLICATIONS. Perrigo, L. D. (Battelle Northwest Labs., Richland, WA). Trans. Am. Nucl. Soc.; 22: 107(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Radiation Sources

Refer also to abstract 20154.

20470 OPTIMIZING A $^{137}CsCl$ RADIATION SOURCE. Libby, R. A. (Battelle Northwest Labs., Richland, WA). Trans. Am. Nucl. Soc.; 22: 108-109(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Industrial Uses

20471 PROGRAM FOR THE BENEFICIAL USE OF RADIOISOTOPIC WASTE. Sivinski, H. D.; Trauth, C. A. Jr.; Whitfield, W. J. (Sandia Labs., Albuquerque, NM). Trans. Am. Nucl. Soc.; 22: 107-108(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20472 APPLICATION OF RADIONUCLIDES IN THE STUDY OF SEDIMENT TRANSPORT AND TREATMENT OF WASTE EFFLUENTS. Case, F. N. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 109-110(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20473 METHOD OF PHOTO-ETCHING AND PHOTOGRAVURE USING FISSION FRAGMENT AND/OR ALPHA RAY ETCH TRACKS FROM TONED PHOTOGRAPHS. Thackray, M. (to Australian Atomic Energy Commission). US Patent 3,922,206. 25 Nov 1975. Priority date 29 Dec 1972, Australia. 10p.

The formation of images on non-photo-receptive surfaces is described. In the past the reproduction of images has involved the initial step of screening the image. The present method does not require such screening and the image produced bears a quantitative and positional relationship to the silver grains present in the photograph from which the image is being produced. The method consists of reproducing a photographic image on a normally non-photo-receptive surface comprising the steps of toning the photograph with substances which combine with or replace the silver grains so that the photograph emits either spontaneously or indirectly fission fragments or alpha particles in amounts related to the distribution of the silver grains in the photograph, and placing the toned photograph contiguous with the surface on which the image is to be reproduced, for sufficient time for the emissions from the photograph to reproduce the image as a radiation-damage image on the surface, the damage areas having a close positional relationship to the silver grains in the original photograph. (auth)

20474 RESIDENCE TIME DISTRIBUTION IN SYSTEMS WITH RECIRCULATION ON THE OUTLET FLOW. Thyn, J. (Ustav pro Vyzkum, Prague); Hansson, L. Int. J. Appl. Radiat. Isot.; 26: No. 12, 748-752(1975).

A method for the analysis of the Residence Time Distribution (RTD) in a system where a fraction of the output flow is recirculated to the inlet is presented. This method (so called direct method) utilizes Laguerre functions and appears to be very useful in radiotracer flow studies. Experimental curves with different disturbances were simulated on a digital computer to investigate the applicability of this method. The practical use of this method is demonstrated on a circular settling basin in a sewage treatment plant. (auth)

LIFE SCIENCES

20475 COMPARISON OF EFFECTS OF ELEVATED TEMPERATURE VERSUS TEMPERATURE FLUCTUATIONS ON REEF CORALS AT KAHE POINT, OAHU. Coles, S. L. (Hawaiian Electric Co., Inc., Honolulu). Pac. Sci.; 29: No. 1, 15-18(Jan 1975).

Bottom temperature and the condition of live corals in the vicinity of the discharge plume from the Hawaiian Electric Company Kahe Generating Station, Oahu, Hawaii, were monitored August–December 1973. Mortality to Pocillopora meandrina, the most thermally sensitive species of the area, was no greater under the conditions of maximum thermal enrichment near the living reef fringe in the discharge area (1–2 m depth) than in an area (4–5 m depth) more distant from the discharge. Sublethal coral damage was more pronounced near the discharge, but was mostly limited to loss of zooxanthellar pigment which was restored following yearly ambient temperature maxima. Although bottom temperatures in the discharge area continually varied 3^0–4^0C within minute periods during every low tide, live corals seldom encountered temperatures exceeding 31^0C. The limited damage that occurred to live corals indicates that upper absolute temperatures are more critical in producing coral damage than are short-term temperature shocks near upper lethal limits. (auth)

20476 BODY TEMPERATURE CHANGE OF BLUEGILL SUNFISH SUBJECTED TO THERMAL SHOCK. Stauffer, J. R.; Dickson, K. L.; Heath, A. G.; Lane, G. W.; Cairns, J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Prog. Fish-Cult.; 37: No. 2, 90-92(Apr 1975).

In order to test the hypothesis that the residence time of a fish in heated effluents can be estimated by comparing its internal temperature with the ambient and discharge temperatures, bluegills were examined under laboratory conditions simulating those of a fossil fuel plant. Experimental temperature conditions were acclimation temperature (1) $+5.5^0$C, (2) $+8.3^0$C, (3) $+11.1^0$C and (4) -11.1^0C. Measurement of time for internal body temperature to reach thermal equilibrium indicated it may be inaccurate to base residence time of fish in a thermal plume on this relationship, since the rate of blood flow of the fish influences the equilibrium. (LK)

20477 INDUCIBLE ERROR-PRONE REPAIR IN ESCHERICHIA COLI. Sedgwick, S. G. (Brookhaven National Lab., Upton, NY). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 7, 2753-2757(Jul 1975).

A hypothesis that ultraviolet-induced mutagenesis arises from the induction of an error-prone mode of postreplication repair that requires the $exrA^+$ $recA^+$ genotype has been tested with alkaline sucrose gradient centrifugation coupled with assays of fixation determined by loss of photoreversibility. The inhibitor of protein synthesis, chloramphenicol, added before irradiation, prevented a small amount of postreplication repair and completely eliminated mutation fixation in E. coli WP2/sub s/ uvrA. However, chloramphenicol did not affect strand joining: (a) in uvrA bacteria allowed 20 min of growth between irradiation and antibiotic treatment; (b) in nonmutable uvrA exrA bacteria; and (c) in uvrA tif bacteria grown at 42^0 for 70 min before irradiation. These observations indicate that an inducible product is involved in a fraction of postreplication repair and is responsible for induced mutagenesis. (auth)

Radiation Effects on Biochemicals

Refer also to abstracts 19730 and 20485.

20478 REDUCTION IN SURFACTANTS BY IRRADIATION. Rohrer, D. M.; Woodbridge, D. D. (Florida Inst. of Tech., Melbourne). Bull. Environ. Contam. Toxicol.; 13: No. 1, 31-36(Jan 1975).

Detergents have been determined to be some of the largest contributors to today's water pollution conditions. Yet pollution is not produced by the total chemical constituents but by certain specific chemical structures. Linear Alkylate Sulfonate (LAS) is used as a wetting agent in certain detergents because it creates an effective surface barrier at the water/air interface. This barrier not only hinders the diffusion of oxygen from the air into the water but also holds in any carbon dioxide produced within the water. The present study was designed to investigate the effect of ionizing radiation on Linear Alkylate Sulfonate to overcome the surface tension effect of detergents. Gamma rays from Cobalt-60 were utilized as the ionizing radiation. This particular material was used because, when encapsulated, it possesses the property of being a pure gamma-ray emitter and has a half-life of 5.24 years. (auth)

20479 RADIATION-INDUCED CHANGES IN COLLAGEN MOLECULE. Dancewicz, A. M. (Inst. of Nuclear Research, Warsaw). Nukleonika; 20: No. 9, 867-875(1975).

The results of investigations aimed at the elucidation of nature and mechanisms of radiation-induced collagen aggregation are briefly reviewed. Collagen solution irradiated in air is more susceptible to the action of proteinases. This effect is most probably responsible for the increased degradation of collagen in the irradiated animals. Tropocollagen irradiated under nitrogen tends to aggregate into dimers and tetramers. These aggregates are branched type polymers. Irradiation in nitrogen induces in collagen three new aldehyde compounds which are probably identical with the three new components reducible with borohydride. Involvement of these components in the formation of intermolecular cross-links seems to be of importance in the mechanism of radiation-induced aggregation and fibrilogenesis of collagen. (auth)

20480 STRUCTURAL CHANGES OF DEOXYRIBONUCLEOPROTEIN FIBRES FOLLOWING γ-IRRADIATION UNDER AEROBIC AND HYPOXIC CONDITIONS. Nakanishi, Y. H.; Kuwabara, M.; Yoshii, G.; Nei, T. (Hokkaido Univ., Sapporo). Experientia; 32: No. 1, 30-32(Jan 1976).

The DNP fibres γ-irradiated under aerobic condition showed a reduction of their diameter, while no remarkable changes were observed in the DNP fibres irradiated under hypoxic condition by scanning electron microscopy. (auth)

20481 COMPLEX FORMATION BETWEEN MENADIONE AND CETYLETHYLMORPHOLINIUM ETHOSULFATE: EFFECT ON UV PHOTODEGRADATION OF MENADIONE. Kowarski, C. R.; Ghandi, H. I. (K and K Labs., Plainview, NY). J. Pharm. Sci.; 64: No. 4, 696-698(Apr 1975).

The process of menadione photodegradation can be enhanced or diminished by other compounds. The presence of the quaternary ammonium compound cetylethylmorpholinium ethosulfate (I) in solutions of menadione was found to slow the rate of photodegradation by uv light (253.7 nm). The mechanism of this effect may be due to complex formation between menadione and I. Complex formation was demonstrated by a shift in the absorption peaks of menadione from 245 and 260 nm to 251.5 and 261.5 nm, respectively. The equilibrium constant of this complex was calculated to be 1.647 M. (auth)

Radiation Effects on Cells

20482 RELATIONSHIPS AMONG REPAIR, CANCER, AND GENETIC DEFICIENCY: OVERVIEW. Setlow, R. B. (Oak Ridge National Lab., TN). pp 711-717 of Molecular Mechanisms for Repair of DNA, Part B. Hanawalt, P. C. (ed.). New York; Plenum Publishing Corp. ([nd]).

The following conclusions are drawn: many different types of damage to DNA may be repaired; a number of completely different types of damage to DNA may be repaired; chemical and physical carcinogens damage DNA, as indicated by direct observation and by the fact that they provoke the sequence of repair steps in DNA; and the use of xeroderma pigmentosum cells—the analogue of excision-deficient bacterial cells—emphasizes the utility of investigating the effects of chemical carcinogens on human cells. (auth)

20483 IMMUNOREACTIVITY TO ANTINUCLEOSIDE ANTIBODIES PERSISTS DURING G2 ARREST IN X-IRRADIATED HeLa CELLS. Bases, R. (Albert Einstein Coll., Bronx, NY); Mendez, F.; Hsu, K. C.; Liebeskind, D. Exp. Cell Res.; 92: No. 2, 505-509(1975).

Arrest of HeLa cells in G2 after ionizing radiation is accompanied by persistent nuclear immunoreactivity to antinucleoside antibodies. The reactivity declined to the normal G2 level during escape from arrest and subsequent cell division. (auth)

20484 SELECTION OF CHINESE HAMSTER SOMATIC CELL MUTANTS AFTER IRRADIATION OF BUdR-LABELLED CELLS. Thirion, J. P.; Labrecque, R.; Vu, T. P. (Univ. of Sherbrooke, Quebec). J. Cell. Physiol.; 87: No. 1, 135-140 (Jan 1976).

The selection of somatic cell mutants after irradiation of BUdR-labelled cells is improved with the use of a mercury lamp combined with a plastic sheet which filters the unwanted wave lengths below 303 nm. New somatic cell mutants defective for galactose metabolism or auxotrophe for fetal calf serum were thus isolated. (auth)

20485 ALTERED GANGLIOSIDE BIOSYNTHESIS IN MOUSE CELL CULTURES FOLLOWING TRANSFORMATION WITH CHEMICAL CARCINOGENS AND X-IRRADIATION. Coleman, P. L.; Fishman, P. H.; Brady, R. O.; Todaro, G. J. (National Inst. of Health, Bethesda, MD). J. Biol. Chem.; 250: No. 1, 55-60(10 Jan 1975).

Chemically and x-ray-transformed subclones of BALB/c 3T3 mouse embryo cells were found to have reduced amounts of the mono- and disialogangliosides galactosyl-N-acetylgalactosaminyl-[N-acetylneuraminyl]-galactosylglucosylceramide (G/sub M^1/) and N-acetylneuraminylgalactosyl-N-acetylgalactosaminyl-[N-acetylneuraminyl]-galactosylglucosylceramide (G/sub D^1a/), and increased amounts of N-acetylgalactosaminyl-[N-acetylneuraminyl]-galactosylglucosylceramide (G/sub M^2/). The activity of the enzyme UDP-Gal:G/sub M^2/ galactosyltransferase was reduced to between 2.7 and 14.3 percent of normal in the transformed clones. Other ganglioside glycosyltransferase activities were unaffected. This enzymatic change was consistent with the observed alteration in ganglioside pattern in the transformed cells. The residual galactosyltransferase activity in the transformed cells was kinetically similar to the normal enzyme, suggesting that transformation alters ganglioside biosynthesis by blocking enzyme synthesis at the translational or transcriptional levels. (auth)

Radiation Effects on Microorganisms

20486 MECHANISM OF GROWTH DELAY INDUCED IN ESCHERICHIA COLI BY NEAR ULTRAVIOLET RADIATION. Ramabhadran, T. V.; Jagger, J. (Univ. of Texas, Dallas). Proc. Natl. Acad. Sci. U.S.A.; 73: No. 1, 59-63(Jan 1976).

Continuously growing cultures of E. coli B/r were irradiated with a fluence of broad-band near-ultraviolet radiation (315 to 405 nm) sufficient to cause extensive growth delay and complete cessation of net RNA synthesis. Chloramphenicol treatment was found to stimulate resumption of RNA synthesis, similar to that observed with chloramphenicol treatment after amino-acid starvation. E. coli strains in which amino-acid starvation does not result in cessation of RNA synthesis ("relaxed" or rel^- strains) show no cessation of growth and only a slight effect on the rate of growth or of RNA synthesis. These findings show that such near-uv fluences do not inactivate the RNA synthetic machinery but affect the regulation of RNA synthesis, in a manner similar to that produced by amino-acid starvation. Such regulation is believed to be mediated through alterations in concentration of guanosine tetraphosphate (ppGpp), and our estimations of ppGpp after near-uv irradiation are consistent with such an interpretation. These data, combined with earlier published data, strongly suggest that the mechanism of near-uv-induced growth delay in E. coli involves partial inactivation of certain tRNA species, which is interpreted by the cell in a manner similar to that of amino-acid starvation, causing a rise in ppGpp levels, a shut-off of net RNA synthesis, and the induction of a growth delay. (auth)

20487 RECOMBINATION-DEFICIENT MUTANTS OF BACILLUS SUBTILIS. Sadaie, Y.; Kada, T. (National Inst. of Genetics, Mishima, Japan). J. Bacteriol.; 125: No. 2, 489-500(Feb 1976).

Two mutant strains of Bacillus subtilis Marburg, NIG43 and NIG45, were isolated. They showed high sensitivities to gamma rays, ultraviolet light (uv), and chemicals. Deficiencies in genetic recombination of these two mutants were shown by the experiments on their capacity in transformation, SPO2 transfection, and PBS1 phage transduction, as well as on their radiation and drug sensitivities and their Hcr^+ capacity for uv-exposed phage M2. Some of these characteristics were compared with those of the known strains possessing the recA1 or recB2 alleles. Mapping studies revealed that the mutation rec-43 of strain NIG43 lies in the region of chromosome replication origin. The order was purA dna-8132 rec-43. Another mutation, rec-45, of strain NIG45 was found to be tightly linked to recA1. The mutation rec-43 reduced mainly the frequency of PBS1 transduction. On the other hand, the mutation rec-45 reduced the frequency of recombination involved both in transformation and PBS1 tranduction. The mutation rec-43 of strain NIG43 is conditional, but rec-45 of strain NIG45 is not. The uv impairment in cellular survival of strain NIG43 was gradually reverted at higher salt or sucrose concentrations, suggesting cellular possession of a mutated gene product whose function is conditional. In contrast to several other recombination-deficient strains, SPO2 lysogens of strains NIG43 and NIG45 were not inducible, indicating involvement of $rec\text{-}43^+$ or $rec\text{-}45^+$ gene product in the development of SPO2 prophage to a vegetative form. The uv-induced deoxyribonucleic acid degradation in vegetative cells was higher in rec-43 and rec-45 strains. (auth)

20488 PROPERTIES OF ADENYL CYCLASE AND CYCLIC ADENOSINE 3', 5'-MONOPHOSPHATE RECEPTOR PROTEIN-DEFICIENT MUTANTS OF ESCHERICHIA COLI. Kumar, S. (Indian Agricultural Research Inst., New Delhi). J. Bacteriol.; 125: No. 2, 545-555(Feb 1976).

Several spontaneous cya and crp mutants of Escherichia coli have been selected as clones simultaneously resistant to phage lambda and nalidixic acid and characterized. Both cya and crp mutants have been found to grow as cocci with increased doubling times. They have increased resistance to some mutagens (methylmethanesulfonate, ultraviolet light, gamma rays), antibiotics (nalidixic acid, ampicillin), phages (lambda, T6), sublethal heat and hypotonic shock, and decreased resistance to neutral detergents (sodium dodecyl sulfate, sodium deoxycholate), a protein synthesis inhibitor (streptomycin), and a respiratory inhibitor (sodium azide). The nature of changes in cell parameters indicate fundamental alterations in the envelope structure of the cya and crp mutant cells. The new cya and crp mutants have been found to be multiply carbohydrate negative and nonmotile in conformity with similar previously isolated mutants. Studies of revertants and phi 80 cya^+ and phi 80 cya transductants indicated that the pleiotropic phenotype is related to a single mutational event at the cya or the crp locus in the mutants. (auth)

20489 INACTIVATION OF CAROTENOID-PRODUCING AND ALBINO STRAINS OF NEUROSPORA CRASSA BY VISIBLE LIGHT, BLACKLIGHT, AND ULTRAVIOLET RADIATION. Blanc, P. L.; Tuveson, R. W.; Sargent, M. L. (Univ. of Illinois, Urbana). J. Bacteriol.; 125: No. 2, 616-625(Feb 1976).

Suspensions of Neurospora crassa conidia were inactivated by blacklight (BL) radiation (300 to 425 nm) in the absence of exogenous photosensitizing compounds. Carotenoid-containing wild-type conidia were less sensitive to BL radiation than albino conidia, showing a dose enhancement factor (DEF) of 1.2 for dose levels resulting in less than 10 percent survival. The same strains were about equally sensitive to shortwave ultraviolet (uv) inactivation. The kinetics of BL inactivation are similar to those of photodynamic inactivation by visible light in the presence of a photosensitizing dye (methylene blue). Only limited inactivation by visible light in the absence of exogenous photosensitizers was observed. BL and UV inactivations are probably caused by different mechanisms since wild-type conidia are only slightly more resistant to BL radiation (DEF equals 1.2 at 1.0 percent survival) than are conidia from a uv-sensitive strain (upr-1, uvs-3). The BL-induced lethal lesions are probably not cyclobutyl pyrimidine dimers since BL-inactivated Haemophilus influenzae transforming deoxyribonucleic acid is not photoreactivated by N. crassa wild-type enzyme extracts, whereas uv-inactivated transforming deoxyribonucleic acid is photoreactivable with this treatment. (auth)

20490 DOMINANCE OF exrB OVER $exrB^+$ IN HETERODIPLOIDS OF ESCHERICHIA COLI. Greenberg, J.; Donch, J.; Berends, L. (Palo Alto Medical Research Foundation, CA). Genet. Res.; 25: No. 1, 39-44(Feb 1975).

To test whether exrB, a mutation in Escherichia coli B making this strain sensitive to ultraviolet radiation and unable to divide normally, is dominant to $exrB^+$, merodiploids were constructed by crossing Hfr exrB $metA^+$ his^+ F^- malB metA thr proA recA. $metA^+$ recombinants were fertile (F') and sensitive to uv. One of these, F' exrB proA, was crossed with an F^- metA malB thr, selecting for $metA^+$ $proA^+$. All such progeny acquiring $malB^+$ were uv-sensitive, fertile and segregated met mal uv-resistant progeny. They were, therefore, meriodiploids, F' exrB/$exrB^+$. exrB is dominant to $exrB^+$, in which respect it resembles exrA (lex). (auth)

Radiation Effects on Plants

20491 (CEA-CONF-3126) PRELIMINARY DATA ON THE EFFECTS OF LOW RADIATION DOSES ON PLANT LIFE. Fabries, M.; Grauby, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Giv-sur-Yvette (France)). 1975. 6p. (CONF-750518-7). Dep. NTIS (US Sales Only) $3.50.

From 3rd European IRPA congress; Amsterdam, Netherlands (13 May 1975).

Initial findings are presented from studies on the effects of low level irradiation on an ecosystem. Previous research on low radiation doses suggests that living organisms are in equilibrium with the radioactivity levels in their environment. Any decrease or increase in the natural radioactivity level seemed to induce modifications in the plant population studied. The radioactivity level thus appears to be an ecological factor just as temperature, humidity, and sunlight. The preliminary experiments reported

were conducted using an artificial ^{137}Co γ source similar to sources likely in the future to cause increased environmental radioactivity from radioactive wastes and nuclear power plants. These experiments showed an apparent reaction threshold of approximately 50 μ rad/hour among spontaneous plant populations. Above this dose the individuals showed the effects of increased size, reduced size, or both effects as the radiation level increased. (EH)

20492 RADIATION-INDUCED POLYGENIC MUTATION IN ARABIDOPSIS THALIANA. V. Analysis of Lines Selected for Numbers of Seeds per Pod. Lawrence, C. W. (Wantage Research Lab., Eng.). Heredity; 34: No. 2, 213-224(1975).

The genetic variation between inbred lines, previously selected for high or low numbers of seed per pod in families arising from plants irradiated with 100, 200, or 300 krads of ^{60}Co γ rays, was analyzed by constructing a 13×13 set of diallel crosses. The analysis showed that the induced mutations were exclusively recessive and suggested the presence of non-allelic interactions. No evidence was found for mutations increasing the number of seeds per pod. In this respect, the induced mutations affecting the number of seeds per pod contrast with those influencing flowering time, since, with these, approximately equal numbers act in the early and late directions. Similarly, flowering time mutations can be either dominant or recessive, dominance is generally incomplete, and their is no evidence for non-allelic interaction. Two out of six low selection lines included in the 13×13 diallel, and one high line, appeared to be homozygous for interchanges or similar chromosome aberrations and these may be responsible for the marked lack of linearity in the relation between selection response and dose. Correlated changes in the unselected character flowering time were negligible in lines selected for number of seeds per pod and vice versa, though one extremely late and infertile line was obtained. (auth)

20493 RADIATION-INDUCED POLYGENIC MUTATION IN ARABIDOPSIS THALIANA. IV. Selection for Number of Seed per Pod. Lawrence, C. W. (Wantage Research Lab., Eng.). Heredity; 34: No. 2, 203-212(1975).

Selection for high and low number of seed per pod was practiced in families derived by selfing single irradiated plants from a homozygous line of Arabidopsis thaliana (Heyn.). Such plants were given a single initial dose of 100, 200, or 300 krads of ^{60}Co γ rays. Selection was also carried out in the control. Selection in the high lines acted principally to reconstitute the control genotype, though this was not entirely successful and most high lines became homozygous for deleterious mutations. "Positive" mutations that increased the number of seeds per pod to above the control level were at best very rare and expressed only in certain environments. Large selection gains were found in the low lines, though their size was not linearly related to dose. This may have been due to the occurrence of chromosome aberrations such as translocations and inversions. The results with this character, probably an important component of fitness, contrast with those obtained previously with flowering time, both with respect to the asymmetry of the selection response and its dose dependence. The low frequency of "positive" mutations suggests that radiation-induced quantitative variation may have only limited value for crop plant improvement. (auth)

20494 RADIATION-INDUCED POLYGENIC MUTATION IN ARABIDOPSIS THALIANA. III. Effect of Parental Genotype and the Limits to Change. Lawrence, C. W. (Wantage Research Lab., Eng.). Heredity; 34: No. 2, 189-201(1975).

Three experiments were carried out designed to examine further the properties of radiation-induced mutations affecting flowering time in Arabidopsis thaliana and some of the variables which influence these properties, such as the genotype of the variety that was irradiated (first experiment) and the factors which influence the accumulation of mutations within a single inbred line (second and third experiments). The average additive effect of the induced mutations was found to be independent of parental genotype, supporting the view that this property depends on the relation between the particular character studied and fitness rather than the frequency of "plus" and "minus" alleles in the parental genome. Considerable response to selection was obtained in families derived by crossing inbred lines which had been previously irradiated and selected, indicating that few of the mutations fixed in these lines were allelic or linked. This result also suggests that each line contained few mutations, each of relatively large effect. Lines which were irradiated and selected every generation showed a linear relationship between response and accumulated dose in both the early and late flowering direction during generations one to five, but a negative response in the early direction and disproportionately large response in the late direction among generations six to nine inclusive. It is suggested that mutations induced in the later generations interact with those fixed in the early generations giving an adverse effect of multiple mutant combinations on fitness. Such interactions may impose limits on the usefulness of induced mutations in plant breeding. (auth)

Radiation Effects on Animals

Man

Refer also to abstract 20917.

20495 (ANL-75-60(Pt.2), pp 74-84) CORTICAL AND TRABECULAR BONE MINERAL MASS IN THE RADIUS AND ULNA. Schlenker, R. A.; VonSeggen, W. W. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

Sites in the distal radius used in the absorptiometric method of bone mineral mass measurement are often assumed to be predominantly trabecular bone. In order to determine the proportion of trabecular and cortical bone at these sites, we ashed and weighed the cortical and trabecular bone from 2-mm thick sections spaced approximately 2.5 mm apart in the most distal 12 cm of radii and ulnae from four women aged 21, 43, 63, and 85 years. The proportion of trabecular bone was found to change rapidly as a function of position in the bone metaphyses, but remained relatively constant as a function of age. In the diaphyses, the proportion of trabecular bone remained relatively constant as a function of position but increased with age. Contrary to the assumption that distal measurement sites are predominantly trabecular bone, we found that trabecular bone varied between 10 percent and 50 percent of the total, depending on the exact location of the site. (auth)

20496 (CEA-R-4669) RECOMMENDATIONS FOR CRITICALITY ACCIDENT DOSIMETRY. (CEA Centre d'Etudes Nucleaires de Cadarache, 13- Saint-Paul-les-Durance (France). Dept. de Surete Nucleaire). Jul 1975. 75p. (In French). Dep. NTIS (US Sales Only) $5.00.

The aims of criticality accident dosimetry and the characteristics peculiar to a critical burst are defined and the requirements to be fulfilled by a personnel dosimetric system that can be applied to this type of measurements are specified. The devices chosen by the C.E.A. Radiation Survey Divisions (simple and cheap) are described along with the main processes to be carried out in order to evaluate doses after an accident. The apparatus necessary for detector counting and the directions for use are presented in detail, allowing standardization of measurements. A set of linear formula enables to obtain, from these measurements, all wanted informations about neutron fluences and spectra, along with the suitable components of the dose at the locations of the irradiated people. (auth)

20497 (ERDA-93, pp 141-146) OCCUPATIONAL HEALTH EXPERIENCE WITH URANIUM IN ORE PROCESSING MILLS. Wilde, R. M. (Nuclear Regulatory Commission, Washington, DC). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

The occupational exposure experience at one large uranium ore processing mill is reviewed. Application of conventional methods of dust control resulted in airborne uranium concentrations that were generally less than 10 percent of the maximum permissible concentration. In-vivo counting of individuals who had been exposed to aerosols that contained daughter-free uranium or to aerosols that contained uranium and daughters indicated that internal deposition and accumulation of measurable amounts of natural uranium, thorium-230, and radium-226 had not occurred after 10 or more years of exposure. (auth)

20498 (ERDA-93, pp 147-159) OCCUPATIONAL HEALTH EXPERIENCE WITH A CONTRACTOR URANIUM REFINERY. Heatherton, R. C. (National Lead Co. of Ohio, Cincinnati). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

This paper presents information related to the occupational exposure of workers in uranium refinery operations at the Feed Materials Production Center since 1958. Included are: a brief history of the FMPC; a description of the operations and the

principal sources of exposure; airborne uranium, urinary excretion, in vivo monitoring and tissue analysis data; and some observations regarding the exposure and health status of employees. (auth)

20499 (ERDA-93, pp 160-166) HEALTH EXPERIENCE IN INDUSTRIAL URANIUM REFINING OPERATIONS. Sinke, G. J.; Grosclaude, C. A. (Kerr-McGee Nuclear Corp., Oklahoma City). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

A modern process is described for the refining and purification of uranium as yellowcake to uranyl nitrate hexahydrate and its subsequent conversion to uranium hexafluoride. Ventilation control equipment is discussed as utilized at the various process stages. The use of respiratory protective equipment is explained. Health physics data for the year 1974 is given including air sampling, urine sampling, and external radiation exposures. The data presented shows that employee exposure to radiation and airborne radioactive material can be maintained at levels well below permissible limits during uranium refining and conversion operations. (auth)

20500 (ERDA-93, pp 167-184) OCCUPATIONAL HEALTH ASPECTS OF A FLUORIDE VOLATILITY PROCESS. Freeman, E. J. (Allied Chemical Corp., Morristown, NJ). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

The Fluoride Volatility process for converting uranium concentrates (U_3O_8) to uranium hexafluoride differs from other processes in that all the steps, except fluorination and distillation, involve handling large volumes of potentially dusty material and that impurities, including daughter products, are not removed until these last steps. The medical and environmental monitoring programs are reviewed and the results summarized, indicating exposures well below the allowable limits. (auth)

20501 (ERDA-93, pp 195-203) INDUSTRIAL FUEL FABRICATION OPERATION. Sanders, C. F.; Bibb, R. D. (Westinghouse Electric Corp., Columbia, SC). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

The Westinghouse-Columbia Plant Health physics protection programs have been established in accordance with the chemical, physical, and radiological properties of the materials associated with each particular manufacturing area. In the chemical conversion area, air samplers have been located in breathing zone areas associated with various work stations. Urine samples are collected on a weekly basis to determine possible blood level concentrations of transportable uranium compounds. In the case of air samples and bioassays, work restrictions are issued at appropriate predetermined levels. Fecal samples are required of those personnel working in areas where there is a potential for exposure to nontransportable uranium compounds. In the ceramic and mechanical areas, urine samples are collected on a monthly basis. In both areas, work is performed with non-transportable compounds only. Fecal samples are required of those personnel receiving more than a 6.8 MPC-hour exposure in any one day. Such data provides a useful basis for establishing the adequacy of the air sampling stations which exist throughout the ceramic and mechanical areas. In-vivo counting is performed on all personnel at least on a yearly basis. Those personnel whose in-vivo counts indicate that there may be between 50 to 75 percent of a maximum permissible lung burden are counted on a quarterly basis. Work restrictions are issued on those personnel who exceed 75 percent of a maximum permissible lung burden. External radiation exposures of personnel located in the radiation areas of the plant are monitored using TLD whole-body badges. Badges are collected on a monthly basis. (auth)

20502 (ERDA-93, pp 205-214) NUCLEAR REGULATORY COMMISSION OCCUPATIONAL EXPOSURE EXPERIENCE AT URANIUM PLANTS. Metzger, J. R. (Nuclear Regulatory Commission, Washington, DC). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

Inspections of Nuclear Regulatory Commission (NRC) licensees are conducted to determine compliance with regulatory requirements. Certain guides, codes and standards are also used as a basis for determining adherence to acceptable standards for radiological safety. The following text describes the experiences NRC inspectors have had in conducting inspections of uranium fuel processing facilities, mills and UF_6 conversion plants. Also included is a summary of the most frequently encountered violations of NRC regulatory requirements. This paper describes experiences in several basic areas of concern. These include contamination levels, airborne radioactivity, external radiation exposures, environmental radioactivity and bioassay programs. (auth)

20503 (ERDA-93, pp 225-243) REVIEW OF URANIUM EXCRETION AND CLINICAL URINALYSIS DATA IN ACCIDENTAL EXPOSURE CASES. Boback, M. W. (National Lead Co. of Ohio, Cincinnati). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

This report reviews urinalysis results obtained following four incidents in which thirteen workers were exposed to high concentrations of airborne uranium. The compounds involved were U_3O_8, UF_6, and uranium ore concentrates. Urine samples collected following these exposures were always analyzed for uranium, and in some cases, for specific gravity, pH, protein, sugar, white blood cells, red blood cells, and casts. Although urinary uranium concentrations exceeded 1 mg U/1, no evidence was found to indicate kidney damage as a result of these exposures. (auth)

20504 (ERDA-93, pp 256-261) REVIEW OF THE BELL STUDY. Marks, S. (Energy Research and Development Administration, Washington, DC). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

The Bell Study of the feasibility of conducting an epidemiologic investigation of the health of workers in a few typical uranium feed plants is reviewed here. The investigators concluded that an epidemiologic study, using plant records, would be feasible. The categories of data that were collected are described in this review. Preliminary analyses of data collected on selected groups of workers and comparison groups were performed in the study and are discussed briefly. (auth)

20505 (IRS-W-17(11-75)) COMPILATION OF DATA CONCERNING POPULATION DISTRIBUTION NEAR THE SITE OF NUCLEAR INSTALLATIONS IN THE FEDERAL REPUBLIC OF GERMANY. Gutschmidt, W. D. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F.R. Germany)). Nov 1975. 103p. (In German). Dep. NTIS (US Sales Only) $5.50.

The report is a compilation of relevant data concerning population distribution near the site of nuclear installations in the Federal Republic of Germany. A classification of German nuclear sites in respect to population distribution is presented. In addition, German and US nuclear sites are compared by use of the site population factor. (auth)

20506 (NP-20773) GUIDE AND EXAMPLE PLAN FOR DEVELOPMENT OF STATE EMERGENCY RESPONSE PLANS AND SYSTEMS FOR TRANSPORTATION: RELATED RADIATION INCIDENTS. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Apr 1975. 94p. Western Interstate Nuclear Board, Lakewood, CO.

As a part of their responsibilities for control of radiation sources and for minimizing unwarranted human exposures to radiation, state radiation control agencies (also referred to as radiological health agencies in some states) have developed or are in the process of developing plans and procedures for coping with emergency situations which may arise from the use, transport, or disposal of radioactive materials and other radiation sources. This guide and example plan has been prepared as an aid to radiation control agencies, emergency services organizations, and other public institutions which may have primary or supportive roles in radiation emergency response planning. This document focuses on planning, training, and emergency action procedures for such organizations and is directed toward transportation-related radiation incidents.

20507 (ORNL/TM-5138) SURVEY OF RADIATION DOSES RECEIVED BY ATOMIC-BOMB SURVIVORS RESIDING IN THE UNITED STATES. Kerr, G. D.; Yamada, H.; Marks, S. (Oak

Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 26p. Dep. NTIS $5.00.

A survey has been completed of 300 of an estimated 500 to 750 survivors of the atomic bombings in Hiroshima and Nagasaki who reside in the United States. Distributions with respect to age, sex, citizenship status, distance from the hypocenter at the time of bombing, and dose from immediate weapon radiation have been tabulated from the results and are presented for this group of 300 survivors. Also presented are survey results concerning exposures to residual radiation from fallout and neutron-induced radioactivity in the areas adjacent to the hypocenter. (auth)

20508 (TID-26953) SECOND ANNUAL REPORT OF CANCER RESEARCH AT THE UNIVERSITY OF CHICAGO, 1974-1975. Slatkin, S. P. (comp.). (Chicago Univ., Ill. (USA)). 1975. 257p. Dep. NTIS $9.00.

Brief summaries are presented of research projects in the following areas: virology, cell biology, tumor immunology, carcinogenesis, clinical research, radiotherapy, radiation physics, nuclear medicine, and care facilities. Descriptions are given of the cancer control center, the clinical cancer training program, and tumor clinics. Cancer-related conferences held at the University of Chicago during the period June, 1974 to June, 1975, are listed. (HLW)

20509 (UCRL-Trans-10754) PROPOSAL FOR METHOD DEVELOPMENT IN BIOLOGICAL DOSIMETRY. Rydberg, B. Jul 1974. Translation of FOA-4-4546-A-4. 12p. Dep. NTIS $3.50.

The frequency of chromosome aberrations in white blood cells can be used as a measurement of the dose absorbed by a person. It is proposed that various methods for separating aberrant chromosomes from the rest should be tested as alternatives to the present manual methods of inspecting chromosomes with the aid of a microscope. A literature search has been made to inquire into this possibility more closely. (auth)

20510 METHOD OF PROTECTING HUMAN SKIN FROM ACTINIC RADIATION. Fusaro, R. M. (to Regents of the University of Minnesota). US Patent 3,920,808. 18 Nov 1975. Filed date 8 May 1973. 8p.

Enhanced protection from sunlight is achieved by applying to human skin beforehand separate, time-spaced applications of (1) a carbonyl compound which is reactive with amino groups in human skin, for example dihydroxyacetone, and (2) a benzo- or napthoquinone such as lawsone. Preferably several sequential applications of each active component in a separate carrier are made the evening before the first exposure, and protection is thereafter maintained by applying each component separately each evening. (auth)

20511 DNA SINGLE-STRAND BREAKS DURING REPAIR OF UV DAMAGE IN HUMAN FIBROBLASTS AND ABNORMALITIES OF REPAIR IN XERODERMA PIGMENTOSUM. Fornace, A. J. Jr.; Kohn, K. W.; Kann, H. E. Jr. (National Cancer Inst., Bethesda, MD). Proc. Natl. Acad. Sci. U.S.A.; 73: No. 1, 39-43(Jan 1976).

The method of DNA alkaline elution was applied to a study of the formation and resealing of DNA single-strand breaks after irradiation of human fibroblasts with ultraviolet light (UV). The general features of the results were consistent with current concepts of DNA excision repair, in that breaks appeared rapidly after uv, and resealed slowly in normal fibroblasts, whereas breaks did not appear in those cells of patients with xeroderma pigmentosum (XP) that are known to have defects in DNA repair synthesis. The appearance of breaks required a short post-uv incubation, consistent with the expected action of an endonuclease. Cells of the variant form of XP characterized by normal DNA repair synthesis exhibited normal production of breaks after uv, but were slower than normal cells in resealing these breaks. This difference was enhanced by caffeine. A model is proposed to relate this finding with a previously described defect in post-replication repair in these XP variant cells. DNA crosslinking appears to cause an underestimate in the measurement of DNA breakage after uv. (auth)

20512 PRACTICAL METHOD TO REDUCE SUBSTANTIALLY THE RADIATION DOSE TO THE BLADDER WALL. Smith, E. M.; Warner, G. G.; Poston, J. W.; Snyder, W. S. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 118-119(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20513 EQUIPMENT AND OPERATIONS FOR PREPARING ^{252}Cf NEUTRON SOURCES FOR INTERSTITIAL CANCER RADIOTHERAPY RESEARCH. Walker, V. W. (E. I. DuPont de Nemours and Co., Aiken, SC). Trans. Am. Nucl. Soc.; 22: 730-731(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20514 DISTRIBUTION OF ABSORBED DOSE OF IONIZING RADIATION IN BONE IN SIMULATED THERAPEUTIC IRRADIATION MEASURED BY MEANS OF ELECTRON SPIN RESONANCE TECHNIQUE. Ostrowski, K. (Medical Academy, Warsaw); Komender, A.; Liniecki, J.; Cisowska, B.; Stachowicz, W.; Michalik, J. Nukleonika; 20: No. 9, 877-880(1975).

The distribution of absorbed dose in irradiated pelvic bones was evaluated by means of electron spin resonance technique. The basis for the measurements is formed by the radiation induced stable paramagnetic centers in the crystalline fraction of bone mineral. The measurements were compared with theoretical isodose distribution. The use of the absorbing tissue itself as a dosimeter is suggested for evaluation of simulated therapeutic irradiation. (auth)

20515 RADIATION SAFETY IN VETERINARY PRACTICE. Code of Practice for the Protection of Persons Exposed to Ionizing Radiations From Veterinary Uses. London; Ministry of Agriculture, Fisheries, and Food (1974). 35p.

It is stated that the Code is based on the recommendations of the International Commission on Radiological Protection and is in harmony with related national codes and legislation. The Code is in chapters, entitled: need for the Code; scope of the Code (establishments, persons, hazards); administrative measures for radiological protection; medical measures for radiological protection; operational measures for radiological protection; premises and equipment for radiography; procedures for radiography (general, large animal radiography, radiography undertaken outside the Designated Area); fluoroscopy; other uses of ionizing radiations (therapeutic use of x-rays, use of sealed radioactive sources, use of unsealed radioactive substances). Appendices include the following topics: maximum permissible doses and dose limits; advisory services; definitions, records, symbols, and specimen local rules. (UK)

20516 HYPERLUCENT LUNG AFTER RADIATION THERAPY. Farmer, W.; Ravin, C.; Schachter, E. N. (Yale Univ., New Haven). Am. Rev. Respir. Dis.; 112: No. 2, 255-258(1975).

A 63-year-old woman was demonstrated to have a hyperlucent lung in a hemithorax irradiated 9 years previously for carcinoma of the breast. This is the second reported concurrence of these events. (auth)

20517 POTENTIAL FOR RADIATION SENSITIZERS AND POSSIBLE STRATEGY FOR USE. Whitmore, G. F. Laryngoscope; 85: No. 7, 1145-1154(Jul 1975).

The search for radiation sensitizers for use in radiotherapy is based on the assumption that proper use of these compounds will provide a differential sensitization of tumor and normal tissue. Based on the evidence that hypoxic cells exist within human tumors but not within normal cell populations, there is reason to believe that specific sensitizers of hypoxic cells might provide useful therapeutic benefit. This paper discusses the possible advantages of such sensitizers, over reliance on the phenomenon of reoxygenation, and describes very briefly the current status of hypoxic cell sensitizers. Finally a proposal is made concerning the way in which such sensitizers might be tested for their efficacy in human radiotherapy. (auth)

20518 IgE ANTIPOLYMYXIN B ANTIBODY FORMATION IN A T CELL-DEPLETED BONE MARROW TRANSPLANT PATIENT. Lakin, J. D.; Grace, W. R.; Sell, K. W. (Naval Medical Research Inst., Bethesda, MD). J. Allergy Clin. Immunol.; 56: No. 2, 94-103(Aug 1975).

The production of IgE-class antibody specific for polymyxin B is documented in an 18-year-old white female acute myelocytic leukemic patient in relapse. The patient was rendered T cell-deficient by total-body x irradiation and antihuman thymocyte globulin for the purpose of bone marrow transplantation. Thereafter, symptoms of nasal congestion, rhinorrhea, and perinasal urtication produced by topical application of a polymyxin solution were noted. Reaginic activity mediated by an IgE antibody against polymyxin is documented by Prausnitz-Kuestner-type passive transfer reactions and by an indirect hemagglutination technique developed for these studies. The occurrence of type I hypersensitivity to this topical antibiotic is rare. It is speculated that pharmaceuticals normally having a low sensitizing potential might demonstrate increased reaginic immunogenicity in a spontaneously or iatrogenically T cell-depleted patient. (auth)

20519 AUTOPSY TECHNIQUES FOR RECOGNITION OF RADIATION INJURY. Warren, S. (Cancer Research Inst., Boston). Bull. Soc. Pharmacol. Environ. Pathol.; 3: No. 2, vp (Jun 1975).

Methods of recognizing accidental or criminal radiation exposures through the detection of radiation injuries at autopsy are

discussed. The various procedures available for use in suspected cases of exposure are briefly discussed. (ERB)

20520 SUCCESSFUL MANAGEMENT OF LICHEN MYXEDEMATOSUS. Hill, T. F. (Medical Coll. of Virginia, Richmond); Crawford, J. N.; Rogers, C. C. Arch. Dermatol.; 112: No. 1, 67-69(Jan 1976).

Radiation therapy led to local resolution of a case of lichen myxedematosus, which, to our knowledge, is the first reported successful treatment of the disease by radiation therapy. Radiation therapy is only the second therapeutic modality that is effective in the treatment of lichen myxedematosus. We propose specific criteria for the diagnosis of lichen myxedematosus to facilitate future studies into the nature of this disease. (auth)

20521 END RESULTS OF RADIATION THERAPY, ALONE AND COMBINATION WITH 5-FLUOROURACIL IN COLORECTAL CANCERS. Vongtama, V.; Douglass, H. O.; Moore, R. H.; Holyoke, E. D.; Webster, J. H. (Roswell Park Memorial Inst., Buffalo). Cancer; 36: No. 6, 2020-2025(Dec 1975).

From 11th international cancer congress; Florence, Italy (20 Oct 1974).

The authors retrospectively analyzed the results of irradiation in 148 cases of primary inoperable and recurrent adenocarcinoma of the colon and rectum treated at the Department of Radiation Therapy, Roswell Park Memorial Institute between 1962 and 1970. This group includes 95 recurrences and 53 inoperable primaries. Uninterrupted radiotherapy was used in 118 cases and split-course technique in 30 cases. Eleven patients received combined radiotherapy and surgery. Seventy-eight patients received a combination of 5-fluorouracil (5-FU) and irradiation. The response rate and survival of individual groups is discussed in detail. This study indicated that perineal recurrences should receive whole pelvic irradiation in addition to perineum field. Split-course technique appeared to yield a better survival than the uninterrupted course. The best 5-year survival rate (64 percent) is found in the group treated with a combination of radiation and surgery. For locally advanced, inoperable cancers, split-course technique, combined 5-FU and irradiation gave the best results, achieving longer palliation with improved quality of life and sometimes yielding cure (5-year survival). (auth)

20522 SKIN COLOR CHANGES IN PSORIASIS. Effect of uv Light Irradiation. Tring, F. C. (Hallamshire Hospital, Sheffield, Eng.). Dermatologica; 147: 309-315(1973).

The change in color of clinically unaffected psoriatic skin resolving concomitantly with distant sites of uv-irradiated psoriatic lesions was measured by a spectrophotometer. Skin color was compared between psoriasis and an area of unaffected skin on a limb protected from uv light while the rest of the body received conventional treatment with uv light. Initially, there was a rapid loss of hue (represented by a flattening of the spectrophotometric curve) while unaffected skin showed elevated measurements which persisted during the course of treatment and subsided slowly for up to 2 weeks after cessation of uv light treatment. Clinically undetectable psoriatic lesions showed persistently raised spectrophotometric measurements for up to 10 weeks after cessation of treatment. This report suggests that a systemic factor stimulated or released by whole body uv light irradiation concomitantly influences the resolution of psoriatic lesions protected from the local effects of uv light. (auth)

20523 SOMATIC AND GENETIC EFFECTS OF LOW-LEVEL RADIATION. Upton, A. C. Prog. At. Med.; 4: 1-40(1974).

Although the biological effects of ionizing radiation are probably better known than those of any other physical or chemical agent in the environment, our information about such effects has come from observations at doses and dose rates which are orders of magnitude higher than natural background environmental radiation levels. Whether, therefore, biological effects occur in response to such low levels can be estimated only by extrapolation, based on assumptions about the dose-effect relationship and the mechanisms of the effects in question. Present knowledge suggests the possibility that several types of biological effects may result from low-level irradiation. The induction of heritable genetic changes in germ cells and carcinogenic changes in somatic cells are considered to be the most important from the standpoint of their potential threat to health. On the basis of existing data, it is possible to make only tentative upper limit estimates of the risks of these effects at low doses. The estimates imply that the frequency of such effects attributable to exposure at natural background radiation levels would constitute only a small fraction of their natural incidence. 148 references. (auth)

20524 IRRADIATION AND MARROW TRANSPLANTATION. Storb, R.; Thomas, E. D. Prog. At. Med.; 4: 161-187(1974).

The concept of bone marrow grafting following whole-body irradiation has left the experimental stage and has been successfully applied to the treatment of a variety of otherwise fatal diseases. Since marrow can be stored indefinitely at low temperatures, it is possible to establish a marrow bank containing specimens of marrow from donors that might be transplanted into unrelated recipients of the same phenotype. 82 references. (CH)

Vertebrates

20525 (COO-3486-3) EFFECTS OF IONIZING RADIATION ON SALAMANDER ORIENTATION. Final Report. Shoop, C. R. (Rhode Island Univ., Kingston (USA). Dept. of Zoology). 1975. Contract E(11-1)-3486. 36p. Dep. NTIS $4.00.

Pens were stocked with larvae of Ambystoma opacum, A. maculatum, and Rana sylvatica and observations were made on survivorship, metamorphosis, size of juveniles, length of larval period, and migration. Migrating adults were irradiated with a ^{137}Cs source; the control and experimental animals were then returned to their points of capture and released. Radiation effects were not evident. Studies were conducted on the uptake and turnover of sodium, praseodymium, and europium by larval and hatchling amphibians and reptiles. (HLW)

20526 DOSE-RATE EFFECTS ON THE HATCHABILITY OF IRRADIATED EMBRYOS OF THE FISH, ORYZIAS LATIPES. Egami, N.; Hama, A. (Tokyo Univ.). Int. J. Radiat. Biol.; 28: No. 3, 273-278(Sep 1975).

A preliminary investigation was done on the effects of dose rates on the radiosensitivity of embryos of Oryzias latipes at different stages of embryonic development. Irradiation of the embryos with 2kR of 180 kVp x rays at 250 R/min showed that radiosensitivity changed during embryonic development. Gamma irradiation at various dose rates showed that effects of γ rays were stronger at the higher dose rates. Gamma irradiation at 25°C and at 4°C showed that the effect of reduced radiosensitivity at low dose-rate only appeared when embryos were exposed at the higher temperature. Dose fractionation demonstrated very low hatchability for single dose irradiation. The majority of fish hatched in the dose-fractionated group if the embryos were maintained at 25°C during the interval, but no dose-fractionation effect appeared if the embryos were kept at 4°C. Irradiation of adult male or female fish followed by mating to an intact partner, yielded data on the effects of dose-rates and dose-fractionation on the hatchability of the embryos. A dose-rate effect was only demonstrated when the mother fish was irradiated, suggesting that recovery from radiation injuries occurs in oocytes but not in mature sperm. (UK)

20527 POSTNATAL DEVELOPMENT OF THE HIPPOCAMPAL DENTATE GYRUS UNDER NORMAL AND EXPERIMENTAL CONDITIONS. Altman, J.; Bayer, S. (Purdue Univ., Lafayette, IN). pp 95-122 of Hippocampus. Vol. 1. Isaacson, R. L.; Pribram, K. H. New York; Plenum Publishing Corp. ([nd]).

Studies on postnatal maturation of the dentate gyrus are reviewed. Some topics discussed are: normal development of the dentate gyrus, cytogenesis, morphogenesis, synaptogenesis, gleogenesis, myelogenesis, development of the gyrus under experimental conditions, and effects of x radiation on cytogenesis and morphogenesis. (HLW)

20528 ALLOTRANSPLANTATION OF LUNG WITHOUT IMMUNOSUPPRESSION AFTER TRANSPLANTATION. I. Staged Transplantation of Bone Marrow and Lung. Blumenstock, D. A.; Kazemi, H.; Hales, C. A.; Cannon, F. D.; Zumwalt, R.; Ferrebee, J. (Mary Imogene Bassett Hospital, Cooperstown, NY). Transplantation; 18: No. 4, 336-342(Oct 1974).

Six of 12 animals are alive 8 to 22 months after transplantation. Five of these animals and one which died of streptococcal pneumonia after pulmonary function testing demonstrated adequate pulmonary function in the transplant. One living recipient has not been studied. Four animals died of a "wasting syndrome" thought to be related to radiation damage to the pancreas rather than graft-versus-host reaction. One animal was killed with a severe skin eruption of unknown cause. (auth)

20529 IS THE MACROPHAGE THE STIMULATING CELL. Talmage, D. W.; Hemmingsen, H. (Univ. of Colorado, Denver). J. Allergy Clin. Immunol.; 55: No. 6, 442-450(Jun 1975).

Using CAF_1 spleen cells to stimulate parental strain BALB/c spleen cells in a mixed lymphocyte culture, column separation of responding cells increased their response whereas the same treatment of stimulating cells reduced their activity approximately 95 percent. Peritoneal macrophages from CAF_1 mice were found to stimulate BALB/c spleen cells poorly if present in comparable numbers or if they were cultured for 24 hours before adding responding cells. However, if the F_1 macrophages were in contact

with the BALB/c cells for only 4 hours, their stimulating effect was increased strikingly. Under these conditions BALB/c macrophages had no effect. It is concluded that the macrophage is probably the most effective stimulating cell and may be the only cell with this capability. (auth)

20530 SURVIVAL OF OOCYTES IN MICE IRRADIATED DURING FOETAL DEVELOPMENT. Rudnicki, T.; Trojczuk, D. (Medical Academy, Warsaw). Nukleonika; 20: No. 9, 881-885 (1975). (In Russian).

The irradiation of the ovaries in mice at 17 day of their foetal development effects progressive reduction of number of oocytes in extrauterine life, mainly at the cost of primitive ones. Stabilization on the level at about 40% of controls takes place in course of sexual maturation. Simultaneously increases the relative number of growing oocytes. The number of mature oocytes remains unchanged. It follows, that in spite of decreasing number of oocytes, reproductive capacity of mice does not exhibit essential change. (auth)

20531 NITROGEN METABOLISM IN THE LIVER, HEART MUSCLE, AND BRAIN AND THE PHYSICAL CHEMICALS FACTORS INFLUENCING ITS SENSITIVITY TO RADIATION. Pikulev, A. T.; Solov'eva, T. I.; Sacateev, I. N.; Khripchenko, I. P.; Chernoguzov, V. M. Biokhimiya (Minsk); No. 2, 216(1974). (In Russian).

Experimental data are presented on the dependence of the radiation-biochemical shifts in glutamic acid metabolism on changes in the physical chemical properties of cell proteins. (Ref. Zh.)

20532 PHYSICAL-CHEMICAL PROPERTIES OF THE MITOCHONDRIA OF THE BRAIN AND THE LIVER OF WHITE RATS DURING TREATMENT WITH X RAYS. Cherkasova, L. S.; Pikulev, A. T.; Mokhoreva, S. I. Biokhimiya (Minsk); No. 2, 43-49 (1974). (In Russian).

A study was made of the process of swelling of the mitochondria of the brain and the liver of white rats in a hypotonic environment under the influence of trypsin and sodium deoxycholate, after one hour and at the end of the first day after general treatment with x radiation in a dose of 40 R. There were two groups of animals, the first group had the adrenal glands removed, the second group had their adrenal glands removed with the subsequent treatment of x rays. In a special series of experiments, the influence was studied of individual hormones on the physical-chemical properties of the mitochondria of the brain and the liver. It was shown that the hormones of the adrenal glands exerted a definite influence on the physical-chemical properties of the brain and liver under the influence of x-ray treatment in relatively small doses. These results provide a possible explanation for the disruption of oxidative phosphorylation processes under the influence of relatively small doses of ionizing radiation. (Ref. Zh.)

20533 EFFECTS OF POLLUTION ON FRESHWATER FISH. McKim, J. M.; Benoit, D. A.; Biesinger, K. E.; Brungs, W. A.; Siefert, R. E. (National Water Quality Lab., Duluth, MN). J. Water Pollut. Control Fed.; 47: No. 6, 1711-1768(Jun 1975).

A review is presented on the effects of pollutants (metal, pesticides, detergents, and industrial and domestic wastes) and water quality parameters (oxygen and pH) on freshwater fish. Methods for the quantitation of PCB, DDT and various elements in fish samples are reviewed. A discussion is given on the response of fish to whole body irradiation with fast neutrons or x radiation, tritium and ^{14}C uptake rates, and effects of ionizing radiation on embryos and larval stages of fish. Other pollutants, such as ground motions from nuclear detonations, increase in five sediments (due to logging and road construction) and aflatoxins are discussed. (FMM)

20534 AGE-RELATED CHANGES IN THE BONE MARROW AND SPLEEN OF SAS/4 MICE. Coggle, J. E.; Gordon, M. Y.; Proukakis, C.; Bogg, C. E. (Medical Coll. of St. Bartholomew's Hospital, London). Gerontologia; 21: No. 1, 1-9(1975).

The total number of nucleated cells in the bone marrow of SAS/4 mice increase some twofold between 1 and 24 months of age but when related to body weight remains essentially constant over a wide range of ages. The concentration of CFU-S in femoral marrow is also constant with age and since other bones containing marrow appear, at least in young mice, to have the same CFU-S concentration as the femur it is concluded that the CFU-S compartment size of the whole bone marrow is independent of age when expressed on a body weight basis. In contrast, both the absolute number and the concentration of exogenous CFU-S in the spleen decline markedly in old mice. Similarly there is a decline in the number of endogenous colony-forming cells and the spleens of 24-month-old mice seem virtually devoid of such colonies. Not only were older mice less capable of supporting the growth of endogenous colonies, but their spleens also appear to provide a poorer environment for exogenous colony growth when compared with growth in younger recipient spleens. (auth)

20535 POSTNATAL DEVELOPMENT OF THE CEREBELLAR CORTEX IN THE RAT. IV. Spatial Organization of Bipolar Cells, Parallel Fibers and Glial Palisades. Altman, J. (Purdue Univ., Lafayette, IN). J. Comp. Neurol.; 163: No. 4, 427-448 (15 Oct 1975).

The ontogeny of the spatial organization of some components of the molecular layer was investigated in cerebella sectioned systematically in the sagittal, coronal and horizontal planes. There is no discernible organization in the distribution of cells of the proliferative zone of the external germinal layer (EGL) but from birth the differentiating bipolar cells of the subproliferative zone are aligned parallel to the surface and to the long axis of the folium. While they are still in or at the base of the EGL, the bipolar cells emit long processes, the future parallel fibers. The next step is the outgrowth of a vertical process which may reach the base of the molecular layer before the granule cell nucleus becomes translocated. The idea that the cell body truly migrates through the molecular layer is not supported by the observations. Bergmann glial cells are frequently seen in Golgi material in neonates but they are probably less numerous than in older infants and their processes are not as well aligned. It is only gradually that the EGL is perforated by glial endfeet which in older infants are occasionally organized into longitudinal rows. In mature cerebella the parallel fibers are separated by thin and relatively narrow, unstained spaces which are oriented in the longitudinal plane and can be traced from the pial surface to a zone just above the layer of Purkinje cells. It is postulated that these spaces are occupied by glial palisades formed by apposed thin vertical processes to which many Bergmann glial cells contribute. The alignment of these palisades is dependent on the orientation of parallel fibers. When the parallel fibers are reoriented by x-irradiation the glial palisades become correspondingly realigned. (auth)

20536 B CELLS IN THE APPENDIX AND OTHER LYMPHOID ORGANS OF THE RABBIT: STIMULATION OF DNA SYNTHESIS BY ANTI-IMMUNOGLOBULIN. Calkins, C. E.; Ozer, H.; Waksman, B. H. (Yale Univ., New Haven). Cell. Immunol.; 18: No. 1, 187-198(Jul 1975).

Lymphocytes from rabbit lymphoid organs were cultured in the presence of class specific anti-immunoglobulin sera and of anti-allotype sera. Stimulation of tritiated thymidine uptake into DNA was taken to indicate the presence of the corresponding immunoglobulins on the cell surfaces. Thymus and bone marrow lymphocytes were unresponsive to all reagents tested. Popliteal lymph node contained cells responsive to anti-mu, anti-gamma, and anti-alpha and therefore presumably bearing IgM, IgG, and IgA. Spleen had only IgM- and IgG-bearing cells, and the appendix contained cells with IgM and IgA receptors only. The lymph node, spleen, and appendix cells of rabbits depleted of B lymphocytes by irradiation (900 R) and injection of thymocytes were unresponsive to anti-immunoglobulin but were stimulated at almost normal levels by PHA and Con A. T cell-depleted animals (thymectomy, irradiation with three divided doses of 450 R and bone marrow shielding) had immunoglobulin-bearing lymphocytes but were unresponsive to the mitogens. However a moderate level of mitogen-responsiveness reappeared by 3 to 4 wk after irradiation. Cells of morphologically distinct regions of the appendix, separated manually, showed different responses corresponding to the inferred origins of these anatomic areas. The "dome" and "corona" contained functional IgM- and IgA-bearing cells. The "TDA" reacted well to PHA, Con A, and PWM, but was depleted of immunoglobulin-bearing cells. The "follicle" cells, which are almost all in active DNA synthesis or mitosis, were relatively unresponsive to either T or B cell stimuli. Anti-allotype serum stimulated the same populations which responded to class-specific heteroantisera but at a slightly lower level. It was inferred that gut-associated lymphoid tissues like the appendix may play a special role as an amplification site for B-cells destined to produce IgM and IgA elsewhere in the organism. (auth)

20537 FURTHER EVIDENCE FOR INHIBIN: CHANGE IN SERUM LUTEINIZING HORMONE AND FOLLICLE-STIMULATING HORMONE LEVELS AFTER X-IRRADIATION OF RAT TESTES. Bain, J.; Keene, J. J. Endocrinol.; 66: No. 2, 279-280(Aug 1975).

Studies of the effects of x-irradiation of rat testes on serum luteinizing hormone (LH) and follicle-stimulating hormone (FSH) levels are reported. FSH levels rose significantly by day 8 after irradiation and continued to rise until day 29. LH concentration rose 51 days after irradiation presumably secondary to Leydig cell damage; however, testosterone levels did not change throughout the experiment suggesting adequate Leydig cell stimulation in response to increased LH secretion. The experiment provided

further evidence that the testicular tubules produce a substance, inhibin, which acts by negative feedback to modulate selectively the secretion of FSH by the pituitary gland. (UK)

Invertebrates

20538 GAMMA RADIATION: ITS EFFECTS ON THE MALE REPRODUCTIVE ORGAN OF THE ORIENTAL FRUIT FLY (DACUS DORSALIS HENDEL). Manoto, E. C. (Phillipine Atomic Energy Commission, Quezon City). Nucleus (Diliman, Quezon City); 13: No. 5, 4-5(Dec 1975).

Following gamma irradiation of adult flies and pupae the testes were removed and prepared for microscopic examination. Results showed a lack of development and atrophy of the testes. Pycnosis and degeneration were observed in the spermatogonia; however, recovery of the spermatogonia occurred 7 days after adult emergence. Effects of radiation on the inseminating capacity of the male were studied by examining the spermatheca of the female after mating with irradiated males. Eggs from these females failed to hatch, indicating dominant lethal mutations in the spermatozoa of the irradiated males. (HLW)

20539 GENETIC ANALYSIS OF THE PROXIMAL REGION OF CHROMOSOME 2 OF DROSOPHILA MELANOGASTER. I. Detachment Products of Compound Autosomes. Hilliker, A. J.; Holm, D. G. (Univ. of British Columbia, Vancouver). Genetics; 81: No. 4, 705-721(Dec 1975).

To examine the genetic composition of proximal heterochromatin in chromosome 2, the detachment of compound second autosomes, for generating proximal deficiencies, appeared a promising method. Compound seconds were detached by gamma radiation. A fraction of the detachment products were recessive lethals owing to proximal deficiencies. Analysis by inter se complementation, pseudo-dominance tests with proximal mutations and allelism tests with known deficiencies provided evidence for at least two loci between the centromere and the light locus in 2L and one locus in 2R between the rolled locus and the centromere. The data further demonstrate that rolled, and probably light, are located within the proximal heterochromatin. Thus, functional genetic loci are found in heterochromatin, albeit at low density. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 20260, 20505, and 20562.

20540 (AECL-5255) INTERNAL RADIOACTIVE CONTAMINATION IN SELECTED GROUPS OF CRNL EMPLOYEES. Evans, D. W. S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1975. 18p. Dep. NTIS (US Sales Only) $3.50. AECL $0.50.

This report details the development and execution of a 30 month program designed to characterize the magnitude and distribution of internal radioactive contamination amongst selected groups of employees at Chalk River Nuclear Laboratories, using a shadow shield whole-body counter. The results show that the levels of contamination in these employees are very low, and no contaminant was present in amounts exceding 10% of the maximum permissible body burden. Details of the time course of some of the body burdens are also furnished. (auth)

20541 (ANL-75-60(Pt.2), pp 39-42) MODEL FOR THE ^{224}Ra-PROTRACTION EFFECT. Groer, P. G.; Marshall, J. H. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

It was pointed out that for a fixed total dose the observed incidence of bone sarcomas in German children and adults exposed to ^{224}Ra was higher the lower the dose rate. Two mathematical models that exhibit a protraction effect are presented in this report. Both models replace cells killed by alpha radiation with normal endosteal cells. This regeneration of cells increases the total number of cells at risk and leads thus to the production of more tumor cells during the longer time periods corresponding to the lower dose rates. (auth)

20542 (ANL-75-60(Pt.2), pp 43-73) DIFFERENCES IN THE CHARACTERISTICS OF CELL CULTURES ESTABLISHED FROM SEVEN HUMAN OSTEOSARCOMAS. Lloyd, E. L.; Henning, C. B.; Mackevicius, F. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

Cell cultures derived from seven human osteosarcomas have been characterized with respect to their pattern of growth and cell morphology using light microscopy, transmission electron microscopy, and scanning electron microscopy. Other characteristics studied included growth rates, chromosomal abnormalities, and ability to grow in low serum concentrations and on a semi-solid substrate. Normal human fibroblasts in culture have also been examined by the same methods. The results show many differences both between individual osteosarcoma cultures and normal fibroblasts. Two of the osteosarcoma cultures were epithelium-like, and five had a more fibroblastic appearance when viewed by the light microscope. Examination by electron microscopy showed a wide variety of cells in each culture. Many of the features exhibited in the fibroblast-like tumor cells were different from those seen with the normal fibroblast cultures. Growth rates differed widely with characteristic doubling times varying between 1 and 7 days for the osteosarcoma cultures, compared to 3 to 4 days for normal fibroblasts. Unlike normal mouse fibroblasts, which grow poorly or not at all in low serum concentrations, the normal human fibroblasts tested grew almost as well in media with 1 percent serum as with 15 percent serum. (auth)

20543 (ANL-75-60(Pt.2), pp 120-127) STUDIES OF THE REPRODUCIBILITY OF MEASUREMENTS OF RADIOACTIVITY IN VIVO. Huff, D.R.; Markum, F.; Essling, M. A. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

A series of experiments is described which was designed to determine the variations caused in gamma-ray measurements of radioactivity in vivo by repeated positioning of a subject in the tilted chair, and by small changes in the position of the detector. The results of a week-long study of two radium cases are presented, and the variations in the measurement of both nonemanating and emanating ^{226}Ra are examined. (auth)

20544 (ANL-75-60(Pt.2), pp 128-130) REVISION OF CONSTANTS USED IN THE CALCULATION OF THE ^{226}Ra CONTENT FOR THE CHRIS FILE VVRA. Essling, M. A.; Markun, F.; Huff, D. R. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

Revised values for certain constants used in the calculation of the body content of ^{226}Ra are listed and modifications of values already entered in file VVRA are noted. (auth)

20545 (ANL-75-60(Pt.2), pp 131-133) MEASUREMENTS OF ATTENUATION COEFFICIENTS FOR URANIUM L X RAYS IN TISSUE-EQUIVALENT ABSORBER. Toohey, R. E. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

The attenuation coefficients at 13.6, 17.2, and 20.2 keV have been measured for a tissue-equivalent material. The results show the material to be marginally suitable for calibration purposes for the detection of ^{239}Pu in vivo. (auth)

20546 (ANL-75-60(Pt.2), pp 149-210) CELL MEDIATED IMMUNITY IN PATIENTS WITH OSTEOSARCOMA. Lloyd, E. L.; Henning, C. B. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

Because of the difficulty of obtaining suitable material, earlier studies on cell mediated immunity in the radium patients failed to include positive controls. Recently we were fortunate in obtaining samples of lymphocytes from two suitable patients who had had amputations for spontaneous osteosarcoma six months previously. Lymphocytes from both of these patients showed cytotoxicity to cultured cells derived from a human osteogenic sarcoma but not to normal fibroblasts. These results help to validate our test for early detection of osteosarcoma in the radium patients using measurements of cytotoxicity. (auth)

20547 (ERDA-93, pp 244-255) CANCER MORTALITY AMONG URANIUM MILL WORKERS. Archer, V. E. (National Inst. for Occupational Safety and Health, Salt Lake City); Wagoner, J. K.; Lundin, F. E. Jr. 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

Mortality from all causes was determined for a small group of uranium mill workers. The only specific cause of death which demonstrated a significant excess was malignant disease of the lymphatic and hematopoietic tissue. Data from animal experiments suggests that this excess may have resulted from irradiation of lymph nodes by thorium-230. (auth)

20548 (ERDA-93, pp 297-322) URANIUM IN MAN BASED ON URINARY EXCRETION DATA. Heid, K. R.; Walsh, W. P.; Houston, J. R. (Battelle Memorial Inst., Richland, WA). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

Generalized models for making prompt and final evaluations of uranium uptakes and resulting dose commitments to lung and bone using urinary excretion data are presented. Pathways and clearance times developed by researchers and accepted by health physicists are described for Class D, W, and Y compounds of uranium. This includes exponential clearance from the lung to blood and clearance from bone described by a power function equation. Although this paper deals with evaluations using urinary excretion data solely, this practice is not recommended since a better evaluation can be made by combining urinary excretion and in vivo examination data. (auth)

20549 (ERDA-93, pp 387-400) OCCUPATIONAL RADIATION EXPOSURE EXPERIENCE: PADUCAH GASEOUS DIFFUSION PLANT. Baker, R. C. (Union Carbide Corp., Paducah, KY). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

The potential for significant uranium exposure in gaseous diffusion plants is very low. The potential for significant radiation exposure in uranium hexafluoride manufacturing is very real. Exposures can be controlled to low levels only through the cooperation and commitment of facility management and operating personnel. Exposure control can be adequately monitored by a combination of air analyses, urinalyses, and measurements of internal deposition as obtained by the IVRML. A program based on control of air-borne uranium exposure has maintained the internal dose of the Paducah Gaseous Diffusion Plant workman to less than one-half the RPG dose to the lung (15 rem/year) and probably to less than one-fourth that dose. (auth)

20550 SUGGESTED REDUCTION OF PERMISSIBLE EXPOSURE TO PLUTONIUM AND OTHER TRANSURANIUM ELEMENTS. Morgan, K. Z. (Georgia Inst. of Tech., Atlanta). Am. Ind. Hyg. Assoc. J.; 36: No. 8, 567-575(Aug 1975).

The historical development of the value of maximum permissible body burden of ^{239}Pu is presented and present considerations for the revision of this standard are given. Some evidence is presented that the linear hypothesis may not be sufficiently conservative at low dose rates and especially for the actinide elements. Until certain questions are answered about the particle problem, it will not be possible to set a satisfactory maximum permissible body burden for ^{239}Pu based on lung as the critical organ, but in the meantime some studies suggest that the present maximum permissible body burden based on bone should be reduced at least by a factor of 200. (auth)

Animals

20551 (ANL-75-60(Pt.2)) RADIOLOGICAL AND ENVIRONMENTAL RESEARCH DIVISION ANNUAL REPORT, JULY 1974-JUNE 1975. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 212p. Dep. NTIS $8.75.

Separate abstracts were prepared for the 18 papers in the report. (HLW)

For abstracts of individual papers see: 20195, 20243, 20495, 20541–20546, 20552, 20555–20561, and 20568.

20552 (ANL-75-60(Pt.2), pp 1-38) THEORY OF THE INDUCTION OF BONE CANCER BY RADIATION: A PRELIMINARY REPORT. I. A Three-Stage Alpha Particle Model and the Data for Radium in Man. Marshall, J. H.; Groer, P. G. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

A model which involves two events of initiation and one of promotion yields an acceptable fit to the induction of osteosarcoma in the human radium cases. A three-dimensional system of analysis shows that the model fits the whole dose-time-response surface, the cumulative incidence versus radium intake, and the time distribution of tumors at each intake level. The two initiation events are produced in an endosteal cell by two alpha particles. The promotion event is related to the local rate of bone remodeling; being unrelated to radiation it provides an explanation for latent period. A competition between initiation and killing of endosteal cells provides an explanation for the plateau of tumor rate both in time and in level of intake for average skeletal doses greater than 1000 rads. (auth)

20553 (BNWL-SA-5563) PULMONARY LESIONS INDUCED BY INHALED PLUTONIUM IN BEAGLES. Dagle, G. E.; Lund, J. E.; Park, J. F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1730. 12p. (CONF-751043–7). Dep. NTIS $3.50.

From workshop on the biological effects and toxicity of ^{239}Pu and ^{226}Ra; Sun Valley, Idaho, USA (6 Oct 1975).

The histopathologic features of pulmonary fibrosis and bronchiolo-alveolar carcinoma in beagles exposed to aerosols of plutonium oxide were reviewed. A hypothesis of the pathogenesis of radiation pneumonitis induced by inhalation of plutonium oxide was presented; this hypothesis included phagocytosis of plutonium particles, fibrosis responding to the necrosis, and alveolar cell hyperplasia compensating for alveolar cells killed by alpha radiation. Histopathologic features of the epithelial changes suggest a progression from hyperplasia to metaplasia and, finally, to bronchiolo-alveolar carcinoma. The possibility of concurrent radiation-induced lymphopenia contributing to the development of bronchiolo-alveolar carcinoma through a loss of immunologic surveillance was discussed. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 20181, 20201, and 22317.

20554 (ERDA-93, pp 436-441) PURPOSES AND FUNCTIONS OF AIR SAMPLING PROGRAMS. Schulte, H. F. (Los Alamos Scientific Lab., NM). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

Air sampling programs can serve many purposes, and the equipment and sampling strategy used will vary with the purpose to be served. This paper describes the distinctive features of uranium air sampling programs for estimating health effects, determining compliance with regulations, evaluating control systems, warning the employee, locating pollution sources, indicating possibilities of explosions, and defining the need for supplemental programs such as bioassay. (auth)

Man

Refer also to abstract 22321.

20555 (ANL-75-60(Pt.2), pp 86-88) PLUTONIUM IN THE BLOOD OF TWO SUBJECTS 10^4 DAYS AFTER INJECTION. Rudo, J.; Larsen, R. P.; Ilcewicz, F. H. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

The excretory plasma clearance of ^{239}Pu in two subjects 10^4 days after intravenous injection was in the range 0.1 to 0.2 l/day. The plasma concentrations per liter were 0.013 percent and 0.043 percent of the retained body contents for the two subjects, respectively. (auth)

20556 (ANL-75-60(Pt.2), pp 89-91) EXCRETION RATE AND RETENTION OF PLUTONIUM 10,000 DAYS AFTER INJECTION. Rundo, J.; Starzyk, P.; Larsen, R. P.; Oldham, R. D.; Sedlet, J.; Robinson, J. J. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

During 1945 to 1947 two persons received intravenous injections of ^{239}Pu as the citrate and one person received ^{238}Pu as the nitrate. Samples of urine and feces were analyzed for Pu for eight days. Results were used to calculate mean daily excretion rates at 10,000 days post-injection. Total excretion and retention were calculated in the form of a balance sheet and results are tabulated. (HLW)

20557 (ANL-75-60(Pt.2), pp 92-95) PRELIMINARY REPORT ON THE MACRODISTRIBUTION OF RADIOACTIVITY IN THE SKELETON OF AN INDIVIDUAL WHO RECEIVED PLUTONIUM BY INTRAVENOUS INJECTION. Toohey, R. E.; Larsen, R. P.; Ilcewicz, F. H. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

The concentration of plutonium has been determined in several bone samples from the skeleton of an individual who had received this element by intravenous injection in 1945. The analyses were based on measurements of uranium L x rays with a large xenon-

filled proportional counter. The results have been confirmed by radiochemical analysis. The presence of ^{241}Am in the samples has been established. The plutonium content of the skeleton estimated from these measurements is consistent with the values obtained from measurements of the microdistributions on bone surfaces. (auth)

20558 (ANL-75-60(Pt.2), pp 98-111) RETENTION AND EXCRETION OF STRONTIUM-90 BY A FORMER DIAL PAINTER (CASE 01-576). Holtzman, R. B.; Ortman, M.; Keane, A. T. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

Excretion rates of ^{90}Sr by a former dial painter, Case 01-576, were determined on excreta collected in 1968. She excreted 249 and 64 pCi/day in urine and feces, respectively, or about 7 percent of the body content per year. Analysis of the data on this subject indicated that the power function described the retention and excretion rates better than did the single exponential. (auth)

20559 (ANL-75-60(Pt.2), pp 112-115) CALCIUM IN BLOOD, PLASMA, AND RED BLOOD CELLS. Kuchta, D. R.; Sha, J. Y. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

The concentrations of calcium in plasma and the cellular fraction of blood and red blood washed by a dilution method to remove entrained plasma were determined. After four washings the cells contained 0.082 +- 0.012 of the total blood calcium. The average concentration of Ca in washed cells was at least an order of magnitude lower than that of the average plasma concentration of 96 mg/kg. (auth)

20560 (ANL-75-60(Pt.2), pp 116-119) INTRALABORATORY COMPARISON OF THE MEASUREMENT OF ^{226}Ra IN SMALL SAMPLES OF HUMAN BONE. Huff, D. R.; Sha, J. Y. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

^{226}Ra was measured in selected samples of human bone by both gamma-ray spectrometry and radiochemical analysis. There appears to be a systematic difference of approximately 8 percent between the two methods; this is about the same as the combined systematic errors which had previously been estimated for these methods. (auth)

20561 (ANL-75-60(Pt.2), pp 134-136) RAPID METHOD FOR ESTIMATING THE EFFECTIVE DEPTH OF INTERNALLY-DEPOSITED ^{241}Am. Toohey, R. E.; Rundo, J. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

The effective depth of the ^{241}Am in a contaminated subject can be estimated by dividing the 60-keV photopeak into roughly equal energy bands and determining the ratio of counts in the lower-energy half to those in the higher-energy half. This ratio was found to be an approximately linear function of the thickness of absorber covering the source over the range of absorber thicknesses of interest. The exact relationship between the ratio and the absorber thickness will be a function of both the energy bands chosen and the particular detector employed. The method is especially applicable to long-term studies of cases of inhalation of ^{241}Am. (HLW)

20562 (ERDA-93) CONFERENCE ON OCCUPATIONAL HEALTH EXPERIENCE WITH URANIUM, ARLINGTON, VIRGINIA, 28–30 APRIL 1975. (Energy Research and Development Administration, Washington, D.C. (USA)). 1975. 461p. (CONF-750445-). Dep. NTIS $13.00.

Separate abstracts were prepared for 18 papers. Six papers were abstracted previously and appeared in NSA volume 32 as numbers 5912, 6044, and 6427, and volume 33 as numbers 992, 3283, and 6370. (CH)

For abstracts of individual papers see: 20497–20504, 20547–20549, 20554, 20563–20566, 20570, and 20571.

20563 (ERDA-93, pp 8-24) EARLY OCCUPATIONAL EXPOSURE EXPERIENCE WITH URANIUM PROCESSING. Eisenbud, M. (New York Univ. Medical Center). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

The uranium production chain during and immediately following World War II is described. The high levels of dust exposure that then existed are summarized in relation to the concentration of uranium found post-mortem in lung and bone. The need for systematic epidemiological followup is emphasized. (auth)

20564 (ERDA-93, pp 25-34) ORIGIN AND BASIS OF PRESENT STANDARDS FOR URANIUM. Hursh, J. B. (Univ. of Rochester, NY). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

The history of the maximum permissible concentration in air, (MPC)/sub a/, for occupational exposure to natural uranium is reviewed. The assumptions made for the calculation of the present (ICRP-NCRP) limits for soluble and insoluble compounds of uranium are stated and commented upon. The point of view is expressed that industrial experience, rather than the validity of the calculations, may now be a more satisfactory justification for safety of the present limits for natural uranium. Limits for single uranium isotopes and for isotope mixtures (other than natural uranium) are considered. (auth)

20565 (ERDA-93, pp 215-224) STATISTICAL SUMMARY OF ERDA CONTRACTORS' INTERNAL ENRICHED URANIUM EXPOSURE EXPERIENCE, 1957-1974. Ross, D. M.; Campbell, C. M. (Energy Research and Development Administration, Washington, DC). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

A compilation is presented of 18 years internal uranium exposure experience of 6 contractors. It is evident that if one expects to detect the presence of uranium in the lung one should have an in-vivo counter available; as these facilities get older more maintenance workers have accumulated uranium lung burdens. Although ERDA contractors have not exceeded the annual lung dose limit during the past 5 years, there may still be room for improvement in the control of airborne uranium in some facilities. (auth)

20566 (ERDA-93, pp 401-418) ROLE OF PARTICLE SIZE IN THE EVALUATION OF URANIUM HAZARDS. Mercer, T. T. (Univ. of Rochester, NY). 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

The pattern of uranium deposition in the respiratory tract, which is determined primarily by size-related particulate properties is shown to be affected significantly by particle densities as large as those of the uranium oxides. The size distributions of pulmonary particulate deposits, estimated from pulmonary deposition curves for dense particles, are roughly lognormal and show modal logarithms in the aerodynamic size range of 0.2 to 3.0 mu m. Solubility clearance constants, which are related to the size distribution of the pulmonary deposit, have been calculated for a number of human exposures. The results are discussed in terms of the significance of particle size. (auth)

20567 PAGET'S DISEASE OF BONE. Serafini, A. N. (Univ. of Miami, Miami Beach, FL). Semin. Nucl. Med.; 6: No. 1, 47-58(Jan 1976).

Nuclear medicine techniques are currently playing an important complementary role in the evaluation, management, and follow-up of the patient who is suspected of having Paget's disease of bone. The earlier diagnoses made possible by some of the described techniques should lead to a better understanding of the basic pathophysiology and, in addition, result in improved therapeutic modalities. (auth)

Animals

Refer also to abstracts 20189, 20204, and 20551.

20568 (ANL-75-60(Pt.2), pp 96-97) PROGRESS REPORT ON THE DEVELOPMENT OF THE FISSION TRACK METHOD FOR THE DETERMINATION OF PLUTONIUM IN BIOLOGICAL MATERIALS. Larsen, R. P.; Oldham, R. D. 1975.

In Radiological and Environmental Research Division annual report, July 1974–June 1975. (Argonne National Lab., Ill. (USA)).

In the development of the fission track method for the determination of plutonium, conditions have been established for limiting the interference of uranium in the determination to a plutonium equivalent of 0.2 fCi. (auth)

20569 (BNWL-SA-5363) OVERVIEW OF PLUTONIUM TOXICITY. Thompson, R. C. (Battelle Pacific Northwest

Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 12p. (CONF-751105-19). Dep. NTIS $3,50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Data are reviewed from studies on the pathological effects of low exposure levels of Pu in dogs, mice, and rats. Emphasis is placed on the incidence of bone tumors following parenteral administration or ingestion of Pu at various concentrations and in various chemical forms and the incidence of lung and bone tumors following inhalation of Pu. Problems involved in the extrapolation of animal data to man and in the extrapolation of low-dose effects to the effects of extremely low doses involved in the environmental dispersion of transuranium compounds are discussed. (CH)

20570 (ERDA-93, pp 67-129) METABOLISM AND EFFECTS OF URANIUM IN ANIMALS. Durbin, P. W. (Univ. of California, Berkeley); Wrenn, M. E. 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

This paper summarizes the results of animal experiments that are the foundation of our current understanding of the biological behavior or uranium. Topics discussed include: metabolism including biological transport, excretion, deposition and retention in kidney and bone; absorption after parenteral administration, feeding, inhalation, or application to skin or eye; maternal transfer; and clearance of inhaled compounds from the lung. Acute chemical toxicity, including mechanism of action and effects on renal tubules; effects on blood and urine chemistry; acute mortality after parenteral administration or application to skin or eye; and the acute toxicity of ^{233}U. Chemical toxicity after prolonged exposure, including mortality; kidney function and pathology during chronic ingestion or inhalation; and tolerance to uranium poisoning. Radiation effects, including induction of bone tumors by soluble ^{232}U or ^{233}U; subacute mortality from ^{233}U; pneumonia and fibrosis in lung and induction of lung tumors by inhaled oxides of ^{235}U or natural U. (auth)

20571 (ERDA-93, pp 130-139) INHALATION OF URANIUM ORES. Stuart, B. O. (Energy Research and Development Administration, Washington, DC); Jackson, P. O. 1975.

From conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In conference on occupational health experience with uranium. (Energy Research and Development Administration, Washington, D. C. (USA)).

In previous studies the biological dispositions of individual long-lived alpha members of the uranium chain (^{238}U, ^{234}U, and ^{230}Th) were determined during and following repeated inhalation exposures of rats to pitchblende (26 percent U_3O_8) ore. Although finely dispersed ore in secular equilibrium was inhaled, $^{230}Th/^{234}U$ radioactivity ratios in the lungs rose from 1.0 to 2.5 during 8 weeks of exposures and increased to 9.2 by four months after cessation of exposures. Marked non-equilibrium levels were also found in the tracheobronchial lymph nodes, kidneys, liver, and femur. Daily exposures of beagle dogs to high levels of this ore for 8 days resulted in lung $^{230}Th/^{234}U$ ratios of greater than 2.0. Daily exposures of dogs to lower levels (0.1 mg/l) for six months, with sacrifice 15 months later, resulted in lung and thoracic lymph node $^{230}Th/^{234}U$ ratios ranging from 3.6 to 9 and nearly 7, respectively. The lungs of hamsters exposed to carnotite (4 percent U_3O_8) ore in current lifespan studies show $^{230}Th/^{234}U$ ratios as high as 2.0 during daily inhalation of this ore in secular equilibrium. Beagle dogs sacrificed after several years of daily inhalations of the same carnotite ore plus radon daughters also showed marked non-equilibrium ratios of $^{230}Th/^{234}U$, ranging from 5.6 to 7.4 in lungs and 6.2 to 9.1 in thoracic lymph nodes. This pattern of higher retention of ^{230}Th than ^{234}U in lungs, thoracic lymph nodes, and other tissues is thus consistent for two types of uranium ore among several species and suggests a reevaluation of maximum permissible air concentrations of ore, currently based only on uranium content. (auth)

20572 ^{65}Zn TRANSFER ACROSS THE PLACENTA AT LATE PREGNANCY IN RAT. Zylicz, E.; Zablotna, R.; Szot, Z. (Inst. of Nuclear Research, Warsaw). Nucleonika; 20: No. 9, 887-896 (1975).

Kinetics of ^{65}Zn deposition in fetuses, allantoic and yolk placenta and some maternal organs were examined in the pregnant rat after i.v. injection of 10 μCi of $^{65}ZnCl_2$. A 24-hr deposition of ^{65}Zn was chosen to study the dependence of deposition on the stage of gestation between the 15th to the 21st day of its duration. The deposition of ^{65}Zn expressed as dose percent per gram of wet tissue reached maximum in fetuses on the 19th day of gestation. In the placentas examined the deposition was elevated between the 16th and 19th day of gestation. In comparison with a non-pregnant female rat the deposition of ^{65}Zn in the body and in selected organs of the pregnant rats was lower during the whole period examined (15th to 21st day of gestation). (auth)

20573 OBSERVATIONS ON THE MECHANISM OF /sup 99m /Tc-LABELED PHOSPHATE COMPLEX UPTAKE IN METABOLIC BONE DISEASE. Rosenthall, L.; Kaye, M. (Montreal General Hospital). Semin. Nucl. Med.; 6: No. 1, 59-67(Jan 1976).

This communication describes a series of clinical and animal in vivo and in vitro investigations designed to elucidate the mechanism of /sup 99m/Tc-Sn-phosphate complex concentration in metabolic bone disease. Rachitic and lathyritic animals were used as experimental models. Based on these studies it is concluded that /sup 99m/Tc alters the pharmacology of the phosphate complexes, in particular pyrophosphate, which was the test agent most extensively employed, so that the usual affinity for mineral is for the greater part replaced by organic matrix binding. There is also evidence to suggest the immature collagen moiety of the organic matrix is the prime target of /sup 99m/Tc-Sn-phosphate complex binding. Specifically, the aldehyde groups of the collagen molecule are suspected as being the major site of interaction. (auth)

20574 SULFURIC ACID EFFECT ON THE DEPOSITION OF RADIOACTIVE AEROSOL IN THE RESPIRATORY TRACT OF GUINEA PIGS. Fairchild, G. A.; Stultz, S.; Coffin, D. L. Am. Ind. Hyg. Assoc. J.; 36: No. 8, 584-594(Aug 1975).

The effect of inhalation of sulfuric acid (H_2SO_4) aerosol on respiratory deposition of radiolabeled streptococcus aerosol was investigated in guinea pigs. A 60 minute exposure to 3020 mu gm/m^3 H_2SO_4 (1.8 mu m CMD) resulted in a 60 percent greater total respiratory deposition rate than control animals and a proximal shift in the regional pattern of deposition to the nasopharynx. Dose-response experiments revealed that a concentration of 30 mu gm/m^3 H_2SO_4 (0.25 mu m CMD) also induced a proximal shift in the regional pattern of particle deposition but in this instance the shift was to the trachea. The interrelationship between mass concentration of H_2SO_4 and its particle size to the interpretation of these results is discussed. A hypothesis concerning the relationship of these data to previously reported respiratory physiologic effects of H_2SO_4 inhalation and to a pathophysiologic mechanism which may underlie effects attributed to sulfur oxides by epidemiologic studies is described. (auth)

20575 ELIMINATION OF ^{137}Cs AND ^{59}Fe AND ITS RELATIONSHIP TO METABOLIC RATES OF WILD SMALL RODENTS. Baker, C. E.; Dunaway, P. B. (Oak Ridge National Lab., TN). J. Exp. Zool.; 192: No. 2, 223-236(1975).

Elimination of ^{137}Cs and ^{59}Fe by three species of wild rodents was measured in laboratory and field experiments to determine whether excretion rates of these nuclides are influenced directly by general metabolic (CO_2 production) rates. Sigmodon hispidus and Peromyscus leucopus were used in both field and laboratory experiments, and Reithrodontomys humulis was investigated only in the laboratory. Final-component biological half-lives (T/sub b/) of ^{59}Fe for Sigmodon averaged 108 days in winter, 144 days in spring, and means ranged from 176 to 242 days under various laboratory conditions (ambient temperature, cold-exposure, irradiation, and chemical metabolic inhibition); for Peromyscus, values were 50 days in winter, 47 days in spring, and 289 days (at ambient temperature only) in the laboratory; for Reithrodontomys mean values ranged from 121 to 178 days at different laboratory treatment levels. Biological half-lives of final-component ^{137}Cs elimination for Sigmodon averaged 7.5 days in winter, 7.9 days in spring, and means ranged from 7.7 to 8.6 days at the different treatment levels in the laboratory. Laboratory mean values for Reithrodontomys ranged from 3.5 to 3.9 days. For Peromyscus, T/sub b/ values averaged 3.4 days in winter, 3.6 days in spring, and 3.5 days in the laboratory. The data suggested that elimination of ^{59}Fe is influenced by metabolic rates of rodents in the field, but laboratory experiments were unable to demonstrate any predictable relationship. Neither did the rate of final-component ^{137}Cs loss from rodents appear to be influenced by metabolic rate. However, final-component Y-axis intercept values of ^{137}Cs exhibited a linear correlation with metabolic rates, and equations were derived from these intercept values to predict metabolism in the field for two species. (auth)

20576 DISTRIBUTION OF /SUP 99m/Tc AND ^{131}I AMONG TISSUES OF THE JAPANESE QUAIL. Robinson, G. A.; Tam, K. H. (Univ. of Guelph, Ont.). Poult. Sci.; 53: No. 6, 2209-2215 (Nov 1974).

In vivo (/sup 99m/Tc) and in vitro (/sup 99m/Tc + ^{131}I) levels in male and laying Japanese quail were measured at 1, 6 and either at 18 or 24 hr. The oocytes accumulated 42 percent of the ^{131}I and 26 percent of the /sup 99m/Tc. Arranging the growing oocytes by maturation sequence, the less mature the oocyte the greater was the nuclide concentration. The thyroid, testes, and plasma also contained greater percentages of ^{131}I than of /sup 99m/Tc. The liver, bile, ceca and kidneys contained, respectively, 17, 19, 207, and 14 times as great a percentage of the /sup 99m/Tc as of the ^{131}I by 18 hours. Seven additional tissues also contained more /sup 99m/Tc than ^{131}I. The proventriculus and gizzard did not concentrate /sup 99m/Tc above levels found in other parts of the digestive tract or in the oviduct. The major routes of excretion of /sup 99m/Tc in the Japanese quail are by way of the growing oocytes (if present), the liver and the kidneys. (auth)

20577 BIOLOGICAL FATE OF A SINGLE ADMINISTRATION OF ^{191}Pt IN RATS FOLLOWING DIFFERENT ROUTES OF EXPOSURE. Moore, W. Jr.; Hysell, D.; Crocker, W.; Stara, J. (Environmental Protection Agency, Cincinnati, OH). Environ. Res.; 9: No. 2, 152-158(Apr 1975).

The retention, tissue distribution, and excretion of ^{191}Pt in adult rats were determined following oral, intravenous (IV), and intratracheal administration. The highest retention was obtained following IV dosing, and lowest retention (less than 0.5 percent) occurred after oral dosing. Tissues containing the highest concentrations of ^{191}Pt following IV administration were the kidney, adrenal, spleen, and liver. Following a single oral dose, almost all of the ^{191}Pt was excreted in the feces due to nonabsorption, whereas after IV dosing, similar quantities were excreted in both the urine and feces. Following IV dosing of pregnant rats, ^{191}Pt was found in all the fetuses; however, the amount was small. (auth)

Plants

20578 (EUR-5375e) ENVIRONMENT AND QUALITY OF LIFE: THE BEHAVIOR OF CHROMIUM IN AQUATIC AND TERRESTRIAL FOOD CHAINS. (Commission of the European Commission of the European Communities, Ispra (Italy). Joint Research Centre). Jul 1975. 88p. Dep. NTIS (US Sales Only) $5.00. EUR FB 200.-.

In exceptional situations, as a result of the direct release of cooling waters, the aquatic environments may receive relatively large quantities of ^{51}Cr. Part of this ^{51}Cr is adsorbed e.g. to the sediments, but a fraction remains in solution in the river water. As an example may be stated the concentration data for Columbia River at 13,5 km downstream from Hanford Nuclear Centre (1 to 10 pCi ^{51}Cr cm^{-3}). Under such circumstances, also soils and crops may be contaminated through irrigation or flooding (e.g. rice) water. Therefore, although ^{51}Cr has a relatively short physical half life, it is of interest to acquire better information on its accumulation by different species of fresh water organisms and plants, as well as on its behavior in soils, in order to evaluate the relative importance of this nuclide in the radioactive contamination of the aquatic and terrestrial food chains. As a related and sometimes associated pollutant, stable chromium is also taken into consideration. This element occurs fairly frequently as an environmental pollutant in many countries, either because of its release to the environment from industrial wastes (e.g. from tanneries, the paint industry, galvanization processes, from factories in which titanium dioxide is prepared, or as an anticorrosion agent added to the cooling water of power stations (see above)). As a result of these industrial processes relatively large amounts of chromium are carried by the waters of rivers such as the Rhine in the Netherlands and the Po in Italy. Estimates for chromium content of salt deposits in the river Rhine vary between 500 and 760 p.p.m. The sequence of presentation of the experimental data is based on the consecutive steps of the contamination process: aquatic environment, soils, plant link of the food chain. Special attention is paid, in the different chapters, to the behavior of various chemical forms of chromium and to their distribution in different fractions: soluble in water, adsorbed, precipitated on particles or complexed with organic material. To obtain an overall picture of this behavior different types of soils and various species were taken into consideration. (auth)

New Tracer Techniques

Refer also to abstracts 19693, 20261, and 21837.

20579 (EUR-5370e, pp 211-214) ACQUISITION AND PROCESSING OF RADIORENOGRAMS. Martinoli, F.; Torresin, G. (CNR, Padua). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The paper deals with the problems concerning acquisition and processing of renograms obtained by resorting to the nuclear techniques (injection of ^{131}I labelled hippuran). A compartmental model is suggested for representing the behavior of the kidneys; the response of such a model is briefly analyzed and its parameters are related to the physiological parameters of the renal function. (auth)

20580 (TID-26984) CURRENT STATUS OF DIAGNOSTIC COUNTING AND IMAGING TECHNIQUES USED IN NUCLEAR MEDICINE: A SKETCH. Beck, R. N. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. 9p. Dep. NTIS $4.50.

Diagnostic procedures used in Nuclear Medicine are designed to provide information about the static and/or dynamic distribution of some particular stable or radioactive material within the patient, as well as the quantity of the material present. Thus, the static distribution of ^{131}I in the thyroid indicates the structure of the gland, whereas changes in the distribution or in the quantity present indicate its rate of functioning. A remarkable variety of techniques, based on emission, transmission, fluorescence, and incoherent holographic imaging principles, have been developed. Both moving and fixed radiation detectors are used, and these produce planar and 3-D projections and transverse sections of the object of interest. In general, the image quality is determined by detector characteristics such as sensitivity, spatial resolution, and depth of field, as well as by the examination time, object contrast, and object intensity, which is always severely limited in the interest of a low radiation dose to the patient. Image processing techniques can be used to improve image quality by removing certain artifacts and by producing a degree of sharpening that is limited by the signal-to-noise ratio. Incoherent holography and optimum-weighted multichannel imaging are presented as two approaches to increasing the signal-to-noise ratio. Alternative criteria for the evaluation of imaging procedures are presented, with emphasis on the use of ROC curves to describe observer performance. (auth)

20581 EVALUATION OF RENAL AND URINARY TRACT ABNORMALITIES NOTED ON SCINTISCANS: A RETROSPECTIVE STUDY OF 1,711 RADIOISOTOPE SKELETAL SURVEYS PERFORMED IN AN 18-MONTH PERIOD. Maher, F. T. Mayo Clin., Proc.; 50: No. 7, 370-378(Jul 1975).

On 247 of the 1,711 scintiscans (15 percent), the appearance of renal or urinary tract areas differed sufficiently from normal to merit mention in interpretation. For 162 patients (195 surveys), the abnormalities noted were classified as minor. For 39 patients (52 surveys), the abnormalities noted were classified as major—that is, confirmed by other means or considered of major importance to diagnosis and management. Of these, 9 were filling defects (2 each were renal cell carcinoma, simple cyst, and polycystic disease; 3 were a mass of undetermined nature) and 30 were unilateral or bilateral urinary tract obstruction indicated by hydroureter and massive retention in renal area(s). These obstructive manifestations were associated with primary pelvic or prostatic malignancy or extension of malignant disease; in nine patients, progression or remission of obstruction was noted on sequential imaging. These changes were compatible with changes in clinical status and may afford an added means of following response to therapy in appropriate patients. (auth)

20582 RADIOIMMUNOASSAY FOR MEASUREMENT OF THYROXINE (T_4) AND TRIIODOTHYONINE (T_3) IN BLOOD SERUM. Chopra, I. J. (to Los Angeles County Harbor General Hospital). US Patent 3,911,096. 7 Oct 1975. Filed date 23 Jun 1972. 14p.

This invention relates to a highly accurate, rapid and simple estimation of thyroxine (T_4) directly from blood serum and also relates to the accurate measurement of triiodo-L-thyronine (T_3) directly from blood serum. More specifically, the invention relates to a rapid, specific and reliable radioimmunoassay (RIA) technique for measurement of both T_4 and T_3 in unextracted serum. The method requires very small amounts of serum, e.g., 25 microliters (mu l) to measure T_4 concentration in nearly all specimens representing clinical states of eu-, hypo- and hyperthyroidism, and 250 mu l to measure T_3 concentrations in specimens representing most clinical states. (auth)

20583 RADIOIMMUNOASSAY OF BOVINE HEART PROTEIN KINASE. Fleischer, N. (Albert Einstein Coll. of Medicine, Bronx, NY); Rosen, O. M.; Reichlin, M. Proc. Natl. Acad. Sci. U.S.A.; 73: No. 1, 54-58(Jan 1976).

Immunization of guinea pigs with bovine cardiac cAMP-dependent protein kinase (ATP : protein phosphotransferase, EC 2.7.1.37) resulted in the development of precipitating antibodies to the cAMP-binding subunit of the enzyme. Both the phosphorylated and nonphosphorylated cAMP-binding protein of the protein kinase

reacted with the antiserum. A radioimmunoassay was developed that detects 10 ng of holoenzyme and permits measurement of enzyme concentrations in bovine cardiac muscle. Bovine liver, kidney, brain, and skeletal muscle contain protein kinases which are immunologically identical to those found in bovine cardiac muscle. However, the proportion of immunoreactive enzyme activity differed for each tissue. All of the immunologically non-reactive enzyme in skeletal muscle and heart was separable from immunoreactive enzyme by chromatography on DEAE-cellulose. Rat tissues and pig heart contained protein kinase activity that cross reacted immunologically in a nonparallel fashion with bovine cardiac enzyme. These results indicate that cAMP-dependent protein kinases within and between species are immunologically heterogeneous. (auth)

20584 ADAPTATION OF A T_3-UPTAKE TEST AND OF RADIOIMMUNOASSAYS FOR SERUM DIGOXIN, THYROXINE, AND TRIIODOTHYRONINE TO AN AUTOMATED RADIOIMMUNOASSAY SYSTEM: "CENTRIA". Ertingshausen, G.; Shapiro, S. I.; Green, G.; Zborowski, G. (Union Carbide Corp., Tarrytown, NY). Clin. Chem.; 21: No. 9, 1305-1313(Aug 1975).

From 7th annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975). See CONF-750319-.

We report the adaptation of four radioassays to the prototype of an automated radioimmunoassay system ("Centria," Union Carbide). The system consists of three integrated modules: an automated pipettor, which dispenses samples and reagents; the key module, an incubator/separator, in which centrifugal force is used to initiate and terminate multiple radioassay incubations and separations simultaneously; and a gamma-counter/computer, which counts three tubes simultaneously and converts counts into concentration units. Radioimmunoassays for thyroxine, triiodothyronine, and digoxin were developed with use of well-characterized antibodies and of prepackaged Sephadex-containing columns to separate bound and free radioactive ligand. A triiodothyronine-uptake test in which the same kind of columns were used was also adapted to the instrument. Results for clinical samples compared favorably with those obtained by manual procedures. We report data on correlation between different methods and preliminary data on precision of the prototype system. (auth)

20585 MODIFICATION OF A COMMERCIALLY AVAILABLE DIGOXIN RADIOIMMUNOASSAY KIT FOR HIGHER PRECISION. van der Vijgh, W. J. F. (Vrije Univ., Amsterdam). Clin. Chem.; 21: No. 8, 1172-1174(Jul 1975).

The procedure prescribed for the Schwarz/Mann ^{125}I-digoxin kit was modified with regard to pipetting and counting procedure. Incubation time with dextran-coated charcoal was also investigated. The modifications resulted in a significantly higher precision without introduction of a systematic error and the analysis time per eight-tube batch was decreased by 20 min. (auth)

20586 RADIOCHEMICALS USED TO SCAN THE HEART. Chem. Eng. News; 53: No. 49, 21-22(8 Dec 1975).

Techniques for heart scanning using ^{201}Tl and /sup 99m/Tc pyrophosphate are discussed. Thallium-201, produced artificially in a cyclotron, concentrates in normal heart muscle but not in abnormal tissue. Technetium-99m is deposited in mitochondria heart cells that are irreversibly damaged. The combined use of ^{201}Tl and /sup 99m/Tc makes it possible to identify regions of recent heart damage as well as older heart damage. Advantages of using ^{129}Cs for heart scanning are also discussed. (HLW)

20587 NONLINEAR PROCESSING METHODS FOR NUCLEAR MEDICINE IMAGES. Bell, P. R.; Bell, M. R.; Dillon, R. S.; Henne, R. L.; Ross, D. A. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 114(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20588 COMPUTER PROCESSING OF MULTIPLE PINHOLE CODED APERTURE SCINTIGRAMS. Stokely, E. M.; Tipton, M. D.; Dowdey, J. E. (Univ. of Texas Health Science Center, Dallas). Trans. Am. Nucl. Soc.; 22: 114-115(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20589 IMAGING TECHNIQUE IN THE THYROID WITH VERY LOW UPTAKE. Bay, R. (Brooklyn–Cumberland Medical Center, NY); Sy, W. M.; Christie, T. Trans. Am. Nucl. Soc.; 22: 116-117(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20590 GATED SCINTILLATION PROBE MEASUREMENT OF LEFT VENTRICULAR FUNCTION. Bacharach, S. L.; Green, M. V.; Douglas, M. A.; Johnston, G. S. (National Institutes of Health, Bethesda, MD). Trans. Am. Nucl. Soc.; 22: 117(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20591 COMPUTERIZED TREATMENT OF RADIONUCLIDIC PLACENTAL STUDIES. Howard, B. Y. (Univ. of Virginia, Charlottesville). Trans. Am. Nucl. Soc.; 22: 117-118(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20592 ^{123}I SODIUM O-IODOHIPPURATE FOR COMPUTER-ASSISTED RENOGRAPHY. Zielinski, F. W.; Robinson, G. D. Jr.; Lee, A. W.; Bocksruker, A. V. (Univ. of California, Los Angeles). Trans. Am. Nucl. Soc.; 22: 118(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20593 UTILITY OF COMPUTER-GENERATED IMAGES IN 130 RADIONUCLIDE RENOGRAPHY STUDIES. Agress, H. Jr. (National Institutes of Health, Bethesda, MD); Levenson, S. M.; Gelfand, M. J.; Johnston, G. S.; Bailey, J. J. Trans. Am. Nucl. Soc.; 22: 125(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20594 HUMAN ANTIBODIES TO BOVINE γ-GLOBULIN. Occurrence in Immunological Disorders and Influence on Allergy Radio-Immunoassays. Foucard, T.; Bennich, H.; Johansson, S. G. O.; Lundkvist, U. (Univ., Uppsala). Int. Arch. Allergy Appl. Immunol.; 48: No. 6, 812-823(1975).

Antibodies to bovine γ-globulin (anti-BGG antibodies) were detectable by a radio-immunoassay in 70% of healthy blood donors but, generally, the titres were low. Significantly increased concentrations of anti-BGG antibodies were found in patients lacking IgA but not in patients with allergic disorders. The anti-BGG antibodies were shown to give rise to falsely high IgE values in the radio-immunosorbent test for IgE determination (RIST) when a sheep anti-IgE antiserum was used. Furthermore, falsely positive results can sometimes be caused by such antibodies in the determination of cow-dander- or cow's-milk-specific IgE by the radio-allergosorbent test (RAST). When a rabbit anti-IgE antiserum was used instead of the sheep anti-IgE, normal IgE levels and negative RAST results were obtained. The difference is explained by the higher degree of cross-reactivity between the anti-BGG antibodies and sheep γ-globulin than between anti-BGG antibodies and rabbit γ-globulin. (auth)

20595 SUICIDAL INSULIN POISONING WITH NINE DAY SURVIVAL: RECOVERY IN BILE AT AUTOPSY BY RADIOIMMUNOASSAY. Sturner, W. Q.; Putnam, R. S. (Univ. of Texas, Dallas). J. Forensic Sci.; 17: No. 4, 514-521(Oct 1972).

From 24th annual meeting of the American Academy of Forensic Sciences; Atlanta, GA, USA (1 Mar 1972).

The discovery of insulin fifty years ago enabled doctors to successfully treat an eleven year old boy dying from diabetes mellitus and thereby ushered in a new medical era. While millions of subsequent patients were thus able to lead productive lives, others turned this miraculous substance into self-destructive purposes, while a few attempted (and possibly succeeded in) carefully concealed homicidal undertakings. The first "murder by insulin" case, prosecuted with a conviction in Great Britain fifteen years ago, employed a laborious bioassay method to demonstrate the hormone at the site of injection. A recent series of insulin poisonings in California was dependent on pathological changes in the brain from anoxia (hypoglycemia) coupled with history and investigation rather than chemical measurements, although an immunoassay method was used for confirmation in the final case. Instances of suicidal attempts by self-administered insulin have been reported with analyses performed by radioimmunoassay, now employed in clinical laboratories to measure many hormonal and therapeutic substances. We have applied this principle from pathologic and toxicologic aspects in an effort to enhance the diagnostic capability of the forensic pathologist, who must examine and properly certify such deaths. (auth)

20596 CHANGES IN MYOCARDIAL BLOOD FLOW AND S-T SEGMENT ELEVATION FOLLOWING CORONARY ARTERY OCCLUSION IN DOGS. Smith, H. J.; Singh, B. N.; Norris, R. M.; John, M. B.; Hurley, P. J. (Michigan State Univ., East Lansing). Circ. Res.; 36: No. 6, 697-705(Jun 1975).

The relationship between regional blood flow and epicardial S-T segment elevation was studied in 26 open-chest anesthetized dogs with left anterior coronary artery ligations. Changes in myocardial blood flow, measured with 15 ± 5 mu (diameter) microspheres labeled with ^{141}Ce, ^{85}Sr, and ^{169}Yb, were correlated with summated S-T segment elevations 15 minutes, 1 hour, and 2 hours after coronary artery occlusion. In normal areas, myocardial blood flow was

113 +- 5 ml/min 100 g^{-1} and summated S-T segment elevation was 0.3 +- 0.2 mv. Fifteen minutes after coronary artery occlusion in 26 dogs, S-T segment elevation was 5.7 +- 0.7 mv over the center of the infarct and myocardial blood flow was 10 +- 1 ml/min 100 g^{-1}; over the border zone, myocardial blood flow was 63 +- 4 ml/min 100 g^{-1} and S-T segment elevation was 3.1 +- 0.1 mv. One third of the areas with a myocardial blood flow of 10 ml/min 100 g^{-1} or less had no S-T segment elevation. In the center and border zones of the infarct in 9 dogs, myocardial blood flow increased from 11 +- 2 and 67 +- 8 ml/min 100 g^{-1} 15 minutes after occlusion to 20 +- 4 and 84 +- 12 ml/min 100 g^{-1}, respectively, 2 hours after coronary artery occlusion. These increases were not associated with a significant reduction in summated S-T segment elevation. The results do not suggest a simple quantitative relationship between epicardial S-T segment elevation and myocardial blood flow following acute coronary artery occlusion. (auth)

20597 FATE OF THYMIC RADIOACTIVITY AFTER LOCAL LABELING WITH ^{125}IODODEOXYURIDINE. Laissue, J. A.; Chanana, A. D.; Cottier, H.; Cronkite, E. P.; Joel, D. D. (Brookhaven National Lab., Upton, NY). Blood; 47: No. 1, 21-30(Jan 1976).

The thymic cortex was locally labeled with ^{125}Iododeoxyuridine (^{125}IUdR) in young adult mice in an attempt to provide a simple quantitative assessment of the fate of cortical thymocytes. Similarly operated and nonoperated mice given ^{125}IUdR intravenously were used for comparison. Analogous experiments were performed in adrenalectomized animals. More than 90 percent of thymic activity present 1 day after labeling had been lost by day 8. That proportion of radioactivity contributed to a given organ by accumulation of labeled thymic migrants was estimated by comparison of values obtained after local labeling with those acquired after systemic labeling. Thymic cell accumulation was apparent in the intestine, spleen, mesenteric lymph node, and femurs of locally labeled mice; however, only a few percent of the total activity lost from the thymus was accounted for in these lymphoid organs. The pattern of fecal and urinary elimination of ^{125}I did not markedly differ in the various experimental groups, the bulk of the activity being recovered in the urine. The intestine could not be ruled out as a major site of thymocyte loss. Since significant radiation or pharmacologic toxicity was unlikely with the doses of ^{125}IUdR used, the data indicated that the vast majority of newly formed thymocytes dies after a short life and only a small fraction of thymic migrants is longer lived. (auth)

20598 ^{67}Ga ACCUMULATION IN PULMONARY LESIONS ASSOCIATED WITH BLEOMYCIN TOXICITY. Richman, S. D.; Levenson, S. M.; Bunn, P. A.; Flinn, G. S.; Johnston, G. S.; DeVita, V. T. (National Institutes of Health, Bethesda, MD). Cancer; 36: No. 6, 1966-1972(Dec 1975).

The radionuclide, gallium-67, accumulates in a wide variety of neoplastic and inflammatory lesions. Diffuse bilateral lung localization of ^{67}Ga occurred in two cases of interstitial pneumonitis associated with bleomycin therapy. Clinical symptoms and laboratory evaluation of pulmonary status correlated with scintigraphic studies in these two patients, while discrepancies between scintigraphic and roentgenographic findings were observed. (auth)

20599 BONE SCANNING: RADIONUCLIDIC REACTION MECHANISMS. Jones, A. G. (Harvard Medical School, Boston); Francis, M. D.; Davis, M. A. Semin. Nucl. Med.; 6: No. 1, 3-18(Jan 1976).

One of the major successes of nuclear medicine in recent years has been the clinical utility of the /sup 99m/Tc-labeled bone-imaging agents. This article is concerned with the evidence available for the mechanisms by which these and other such radiopharmaceuticals localize at sites in the skeleton. (auth)

20600 COMPARISON OF /sup 99m/Tc-LABELED PHOSPHATE AND PHOSPHONATE AGENTS FOR SKELETAL IMAGING. Davis, M. A.; Jones, A. G. (Harvard Medical School, Boston). Semin. Nucl. Med.; 6: No. 1, 19-31(Jan 1976).

The use of /sup 99m/Tc-labeled phosphate and phosphonate compounds in place of ^{18}F, ^{85}Sr, and /sup 87m/Sr for bone scintigraphy has become commonplace throughout the world in a relatively short time. The labeling of polyphosphate with /sup 99m/Tc 4 years ago, followed rapidly by the introduction of /sup 99m/Tc-labeled pyrophosphate for skeletal imaging, must therefore be regarded as a major contribution to the practice of diagnostic nuclear medicine. The markedly reduced patient radiation exposure and concomitant increase in photon detection efficiency derived from the more favorable physical decay characteristics of /sup 99m/Tc led to increased sensitivity and resolution and in turn to improved diagnostic efficacy. The subsequent clinical use of the phosphonate complex /sup 99m/Tc-HEDP represented a further modification of the same basic approach. Current clinical trials with /sup 99m/Tc-labeled methylene diphosphonic acid (MDP), which appears to demonstrate enhanced biologic properties for scintigraphy of the osseous structures, is the latest example in this series of refinements. This article compares the technetium-labeled agents already in clinical use and, using animal data, contrasts them with several new multifunctional phosphonates and the novel inorganic compound sodium imidodiphosphate (IDP). In addition, an attempt is made to clarify the conflicting evidence in the nuclear medicine literature regarding the relationship between polyphosphate chain length and skeletal uptake. (auth)

20601 BENIGN BONE TUMORS. Gilday, D. L.; Ash, J. M. (Hospital for Sick Children, Toronto). Semin. Nucl. Med.; 6: No. 1, 33-46(Jan 1976).

There is little information in the literature concerning the role of bone scanning in benign bone neoplasms except for sporadic reports. Since the advent of /sup 99m/Tc-polyphosphate, bone imaging has proven feasible and useful in locating the cause of bone pain, such as in osteoid osteomas, which are not always radiologically apparent, and in evaluating whether or not a radiologic lesion is indeed benign and solitary. Blood-pool images are particularly important in neoplastic disease, since the absence of hyperemia in the immediate postinjection period favors the diagnosis of a benign neoplasm, as does low-grade uptake on the delayed study. The scan, including pinhole magnification images, is especially valuable in diagnosing lesions in the spine and pelvis, which are poorly seen radiologically. We have studied various types of benign bone tumors, including simple and aneurysmal bone cysts, fibrous cortical defects, and nonossifying fibromas, all of which had minimal or no increased uptake of the radiopharmaceutical, unless traumatized. Although osteochondromas and enchondromas showed varied accumulation of activity, the scan was useful in differentiating these from sarcomatous lesions. All osteoid osteomas demonstrated marked activity, and could be accurately located preoperatively, as could the extent of fibrous dysplasia. The bone scan in the reticuloses also showed abnormal accumulation of activity, and aided in arriving at the prognosis and treatment of histiocytic bone lesions. (auth)

20602 PINHOLE IMAGING IN LEGG–PERTHES DISEASE: FURTHER OBSERVATIONS. Danigelis, J. A. (Newington Children's Hospital, CT). Semin. Nucl. Med.; 6: No. 1, 69-82(Jan 1976).

Fifty-nine patients with Legg–Perthes disease and 12 others were studied using /sup 99m/Tc-polyphosphate and the pinhole collimator imaging technique. Radiographs of both hips were correlated with images in each patient. In the Legg–Perthes patients, a radionuclide uptake deficiency of variable size was observed in the proximal femoral epiphysis (EOC), which we believe is related to varying degrees of impaired blood supply. During later disease stages, adjacent zones of increased radionuclide activity or revascularization were observed that would replace the uptake defect eventually. Unless radiographic evidence of new bone formation was observed in the EOC, it was impossible to predict either the presence or extent of revascularization until bone imaging was done. Those patients with revascularization activity in the EOC exhibited a relatively short time interval (average, 3.2 months) before evidence of new bone formation radiographically. Others with increased radionuclide concentration limited to the growth plate and/or metaphysis averaged a much longer 7.8 months. In two patients there was a reversal of the initially increased activity in the growth plate, suggesting another vascular insult. There were no false-negative bone-image findings in the 12 cases that clinically and/or radiologically simulated Legg-Perthes disease. Our image studies correlate well with published histopathologic investigations, indicating to us that assessment of extent of pathologic involvement and of the disease course is facilitated by this technique. Subsequently, this could influence treatment selection and provide a more objective baseline from which to judge treatment results. Continued experience suggests pinhole bone imaging has useful clinical application in Legg–Perthes disease and other childhood hip disorders. (auth)

20603 BONE AND MARROW IMAGING IN SICKLE CELL DISEASE: DIAGNOSIS OF INFARCTION. Lutzker, L. G. (Albert Einstein Coll, Bronx, NY); Alavi, A. Semin. Nucl. Med.; 6: No. 1, 83-93(Jan 1976).

Sickling of erythrocytes in patients with S-hemoglobin causes marrow and bone infarction. The former can be demonstrated as a lack of /sup 99m/Tc-sulfur colloid uptake on marrow imaging examination. These defects may resolve or persist long after the acute episode. If the bone is involved in the acute

episode, imaging within the first few days of onset of symptoms can show lack of /sup 99m/Tc-labeled phosphate uptake, usually in a smaller area than that shown by marrow scanning. Follow-up bone imaging shows increased activity, particularly along the circumference of the bone where periosteal reaction can be demonstrated radiographically. Magnification by use of the pinhole collimator provides better definition of the uptake defect and the distribution of the increased reactive uptake. Timing of examination is important. If marrow imaging is performed in an asymptomatic period, the repeat examination during a painful crisis permits differentiation of old and acute marrow infarction. If /sup 99m/Tc-phosphate imaging is performed after about 2 days of symptoms, acute infarction can be differentiated from osteomyelitis, which it may mimic clinically. To assist in differentiating bone infection in a site of marrow infarction demonstrated by marrow imaging, serial bone imaging with magnification may be useful. The uptake defect, followed in several days to 2 weeks, by circumferential increased activity, is a different pattern than the homogeneously intense activity of osteomyelitis, but the peripheral distribution may not be apparent on routine imaging. It is hoped that the utilization of these techniques can decrease the emotional and economic costs of prolonged hospitalization for suspected infection and can also expand our knowledge of the complex pathophysiologic changes of sickle cell bone disease. (auth)

20604 BONE SCAN IN INFLAMMATORY OSSEOUS DISEASE. Handmaker, H.; Leonards, R. (Children's Hospital, San Francisco). Semin. Nucl. Med.; 6: No. 1, 95-103(Jan 1976).

The /sup 99m/Tc-phosphate bone scan has become a sensitive, reliable, and safe method for evaluating the patient with suspected inflammatory disease of bone. The scan may become positive as early as the first 24 hr after the symptoms and 10-14 days before roentgenographic changes occur. It can be used to differentiate successfully a variety of diseases from osteomyelitis, and in conjunction with ^{67}Ga-citrate scan has become a mainstay in the work-up of the patient with infectious disease. Applications of the bone scan to infectious diseases in pediatric practice are especially helpful, since these diseases are common problems in this age group. Increased experience with the /sup 99m/Tc-phosphate bone scan has already defined several areas of "limitations" in evaluating inflammatory disease. "Cold" defects, negative scans in early stages of osteomyelitis, and "extended uptake" may all pose problems in interpretation, but careful correlation of the bone scan results with clinical history and physical findings, blood cultures, and roentgenography will significantly reduce these problems. (auth)

20605 BONE TRAUMA AND RELATED BENIGN DISEASE: ASSESSMENT BY BONE SCANNING. Marty, R.; Denney, J. D.; McKamey, M. R.; Rowley, M. J. (Swedish Hospital Medical Center, Seattle). Semin. Nucl. Med.; 6: No. 1, 107-120(Jan 1976).

The radionuclide investigation of skeletal trauma in the past was confined generally to scintimetry and an occasional bone scan. The development of improved radiopharmaceuticals, including /sup 99m/Tc-labeled compounds with their enhanced sensitivity, and the refinement of imaging devices offering superior resolution and speed have allowed a more detailed assessment of conditions resulting from trauma. Practical approaches to the diagnosis of subtle bone injury resulting in stress fracture, the differentiation between delayed healing and nonunion, and early recognition of avascular necrosis and osteomyelitis are now available. The changing pattern of radionuclide uptake in bone following damage by radiation and other abnormalities as a consequence of trauma also can be easily studied. (auth)

20606 RADIONUCLIDE JOINT IMAGING. Hoffer, P. B.; Genant, H. K. (Univ. of California, San Francisco). Semin. Nucl. Med.; 6: No. 1, 121-137(Jan 1976).

Modern radionuclide techniques of joint imaging involve the use of either /sup 99m/Tc-pertechnetate or /sup 99m/Tc-phosphate compounds in conjunction with the Anger camera. In general, images obtained with both types of radiocompound are non-specific—although increased uptake of /sup 99m/Tc-pertechnetate usually denotes the presence of synovitis. The most popular uses of the technique are in documenting the extent and severity of inflammatory joint disease, assessing the effect of therapy, and establishing the diagnoses of Legg-Perthes disease and septic arthritis. The method is also useful in judging the extent of involvement in osteoarthritis of the knee prior to surgical intervention. Radionuclide joint imaging is more sensitive than clinical or radiographic techniques in detecting early joint involvement but usually it must be supplemented by other techniques to establish a specific diagnosis. (auth)

20607 RADIOIMMUNOASSAY FOR ISONIAZID. Schwenk, R.; Kelly, K.; Tse, K. S.; Sehon, A. H. (Univ. of Manitoba, Winnipeg). Clin. Chem.; 21: No. 8, 1059-1062(1975).

A sensitive radioimmunoassay is described, for measuring isoniazid in therapeutic and subtherapeutic concentrations. This radioimmunoassay was used in an exploratory clinical study to measure, as a function of time, the concentration of this drug in plasma of patients receiving isoniazid therapy. (auth)

20608 STANDARDIZATION OF INCUBATION TIME AND TEMPERATURE FOR EIGHT RADIOIMMUNOASSAYS. Lenz, P. H. (Fairleigh Dickinson Univ., Madison, NJ); Wien, G. H.; Toth, J. M. Clin. Chem.; 21: No. 8, 1169-1171(1975).

We wanted to know if incubation time and temperature for many radioimmunoassay methods could be standardized, to decrease assay time and so improve efficiency. Percentage binding was determined for triiodothyronine, thyroxine, digoxin, digitoxin, testosterone, aldosterone, estradiol, and diphenylhydantoin when the reaction mixtures were incubated at 6 to 8, 22, or 37°C for various periods of time. In all methods tested, binding of antigen to antibody was greatest when the reaction mixtures were incubated at 6 to 8°C, less at 22°C, and least at 37°C. Maximum binding occurred within 30 to 60 min at each temperature for all methods tested. Hence, it is possible to standardize the incubation time and temperature for these eight radioimmunoassay methods to 60 min at 6 to 8°C. (auth)

20609 RADIONUCLIDE ANGIOCARDIOGRAPHY. Improved Diagnosis and Quantitation of Left-to-Right Shunts Using Area Ratio Techniques in Children. Alderson, P. O.; Jost, R. G.; Strauss, A. W.; Boonvisut, S.; Markham, J. (Washington Univ., St. Louis). Circulation; 51: No. 6, 1136-1143(Jun 1975).

A comparison of several reported methods for detection and quantitation of left-to-right shunts by radionuclides was performed in 50 children. Count ratio (C2/C1) techniques were compared with the exponential extrapolation and gamma function area ratio techniques. C2/C1 ratios accurately detected shunts and could reliably separate shunts from normals, but there was a high rate of false positives in children with valvular heart disease. The area ratio methods provided more accurate shunt quantitation and a better separation of patients with valvular heart disease than did the C2/C1 ratio. The gamma function method showed a higher correlation with oximetry than the exponential method, but the difference was not statistically significant. For accurate shunt quantitation and a reliable separation of patients with valvular heart disease from those with shunts, area ratio calculations are preferable to the C2/C1 ratio. (auth)

20610 DIGITAL IMAGE PROCESSING IN RADIOISOTOPE SCANNING. King, R. E. (City Univ., New York). IEEE Trans. Bio-Med. Eng.; 21: No. 5, 414-416(Sep 1974).

The ready availability and high speeds of small digital processors (minicomputers) has made possible fast translation to and from discrete time and frequency domains through the fast Fourier transform (FFT). Formerly time-consuming operations on sequences can now be performed more efficiently and easily in the discrete frequency domain. The FFT lends itself naturally to image processing and enhancement and in this communication is applied to line by line image processing of radioisotope scan data. The method has the potential of a vastly improved and more versatile display over existing line by line continuous methods, providing for detector point-spread distortion correction, variable spatial smoothing, line and area counts, data interpolation, and synthetic color coding for enhanced tube (CRT) display. (auth)

20611 RECENT ADVANCES IN NUCLEAR MEDICINE. Lawrence, J. H. (ed.), Progress in Atomic Medicine. Vol. 4. New York; Grune and Stratton, Inc. (1974). 278p.

Separate abstracts were prepared for four chapters. Abstracts of two chapters appeared previously in NSA vol. 31 as number 33627 and vol. 32 as number 1107. (CH)

For abstracts of individual chapters see: 20523, 20524, 20612, and 20613.

20612 CORRELATION OF ULTRASONIC AND NUCLEAR MEDICINE TECHNIQUES. Winston, M. A.; Pritchard, J. H.; Blahd, W. H. Prog. At. Med.; 4: 215-233(1974).

The rapid strides made during the past few years in ultrasonic instrumentation and technique have resulted in an extremely useful new diagnostic tool for neoplasms localization. Like radioisotope nuclear scanning, ultrasonography is well adapted to the study of solid organs. The nuclear medicine physician, therefore, should be aware of the many areas in which the two techniques are complementary, as well as those in which the newer modality seems likely to replace the older one. 59 references. (auth)

20613 RADIOISOTOPIC STUDIES OF GROWTH, DEVELOPMENT, AND REGENERATION. Spencer, R. P. Prog. At. Med.; 4: 235-250(1974).

Some radioisotopic approaches for following aspects of growth, development, and regeneration during life have been outlined. Despite their limitations, these techniques might provide fresh insights as to the rate and control of key biological events. 55 references. (auth)

20614 NEW SOLID PHASE RADIOIMMUNOASSAY (CLB-RIA) FOR THE DETECTION OF HEPATITIS-B ANTIGEN AND ANTIBODY. Duimel, W. J. (Centraal Laboratorium van de Bloedtransfusiedienst, Amsterdam); Brummelhuis, H. G. J. Vox. Sang.; 29: No. 1, 1-14(1975).

A new competitive solid phase radioimmunoassay (CLB-RIA) has been developed for the detection of HBAg and HBAb in human serum and plasma. In the assay, sheep antibodies to HBAg, covalently linked to an insoluble carrier, highly purified ^{125}I labelled HBAg and the serum or plasma sample are incubated for 20 h at room temperature. After incubation, the bound and the free fraction of the tracer are separated by centrifugation. Both the presence of HBAg and HBAb, result in a decrease of the amount of bound tracer, when compared with a negative control serum. Differentiation between HBAg and HBAb requires the use of another type of radioimmunoassay. For this purpose a sandwich solid phase radioimmunoassay, for the detection of HBAb only, has been developed (CLB-AURIA). In this, assay-purified HBAg is covalently linked to an insoluble carrier. Using a mixture of both immunosorbents (insolubilized HBAg and HBAb), it is possible to detect and to distinguish HBAg and HBAb in one single solid phase radioimmunoassay (CLB-MIRIA). The influence of three parameters on the CLB-RIA, the incubation time, the amount of tracer and the effect of Tween-20 has been studied. The sensitivity of the described solid phase CLB-RIA for the detection of HBAg is comparable to that of other radioimmunoassays reported in literature; its specificity is very high. (auth)

20615 MEASUREMENT OF GASTRIC BLOOD FLOW WITH RADIOACTIVE MICROSPHERES. Archibald, L. H.; Moody, F. G.; Simons, M. (Univ. of Utah, Salt Lake City). J. Appl. Physiol.; 38: No. 6, 1051-1056(Jun 1975).

The validity of using radioactive microspheres (15 +- 5-mu m diameter) to measure gastric blood flow and its partition between gastric wall layers was investigated in anesthetized dogs with a chambered segment of gastric corpus. Total flow measured by a venous effluent technique demonstrated close correlation with microsphere-measured flow (r equals 0.98, slope equals 0.95) in 12 dogs given histamine, gastrin, or isoproterenol. In 12 histamine-stimulated dogs, mucosal flow measured by aminopyrine clearance and by microspheres also showed good agreement (r equals 0.96, slope equals 0.83). No evidence was found to indicate that microspheres altered hemodynamic or gastric function. In all experiments less than 1 percent of the total gastric radioactivity passed through arteriovenous shunts. The mucosa always contained a statistically adequate number of spheres (greater than 400), but the submucosa and muscularis frequently did not. Microspheres of all sizes mixed adequately in large arteries, but a significant difference was found in the distribution of 16- and 16-mu m spheres between mucosa and submucosa, presumably because of streaming of the larger spheres past mucosal arteries. It was concluded that, with the techniques developed in our laboratory, microspheres could be a highly useful tool for quantitating gastric regional blood flow under a variety of experimental conditions. (auth)

20616 STRENGTH OF PULMONARY VASCULAR RESPONSE TO REGIONAL ALVEOLAR HYPOXIA. Hales, C. A.; Ahluwalia, B.; Kazemi, H. (Massachusetts General Hospital, Boston). J. Appl. Physiol.; 38: No. 6, 1083-1087(Jun 1975).

Regional alveolar hypoxia in the lung induces regional pulmonary vasoconstriction which diverts blood flow from the hypoxic area. However, the predominant determinant of the distribution of perfusion in the normal erect lung is gravity so that more perfusion occurs at the base than at the apex. To determine the strength of the regional alveolar hypoxic response in diverting flow with or against the gravity gradient a divided tracheal cannula was placed in anesthetized dogs and unilateral alveolar hypoxia created by ventilating one lung with nitrogen while ventilating the other lung with oxygen to preserve normal systemic oxygenation. Scintigrams of the distribution of perfusion obtained with intravenous ^{13}N and the MGH positron camera revealed a 34 and 32 percent decrease in perfusion to the hypoxic lung in the supine and erect positions and a 26 percent decrease in the decubitus position with the hypoxic lung dependent (P equals 0.94 from supine shift), indicating nearly equal vasoconstriction with shift of perfusion away from the hypoxic lung in all positions. Analysis of regional shifts in perfusion revealed an equal vasoconstrictor response from apex to base in the supine position but a greater response in the lower lung zones in the erect position where perfusion was also greatest. (auth)

20617 DIAGNOSIS OF PULMONARY EMBOLISM IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE. Sharma, G. V. R. K.; Sasahara, A. A. (Harvard Medical School, Boston). J. Chronic Dis.; 28: No. 5-6, 253-257(Jun 1975).

The difficulties in diagnosing pulmonary embolism are discussed with emphasis on the role of chronic obstructive pulmonary disease in increasing the difficulties. Perfusion lung scanning is a major screening test for pulmonary embolism. The importance of a multiple view scan is emphasized. Chronic obstructive pulmonary disease is the most common cause of nonembolic perfusion defects. Pulmonary angiography is usually required for diagnostic confirmation. Ventilation-perfusion studies employing ^{133}Xe have been reported to show characteristic changes indicative of pulmonary embolism in patients with chronic obstructive pulmonary disease. (HLW)

20618 VALUE OF ^{67}Ga SCANNING IN THE EVALUATION OF HEAD AND NECK MALIGNANCY. Smith, N. J.; Teates, C. D.; El-Mahdi, A. M.; Fitz-Hugh, G. S.; Constable, W. C. (Univ. of Virginia, Charlottesville). Laryngoscope; 85: No. 5, 778-786 (May 1975).

From centennial conference on laryngeal cancer; Toronto, Canada (27 May 1974).

Gallium (^{67}Ga) citrate is a scanning agent that has been shown to have a differential uptake in a variety of malignancies. Investigation of the usefulness of ^{67}Ga scanning in patients with proven squamous cell carcinoma of the head and neck region is now in progress. These patients have a ^{67}Ga total body scan as part of the pre-treatment evaluation. The accuracy of the procedure is then judged by correlation with clinical and surgical findings. The results in 25 patients show that a clearly positive uptake occurs in 60 percent in the region of the primary. Uptake in metastatic disease in lymph nodes is much less, occurring in 6 of 18 sides of the neck. In one case, where clinical examination was considered to be negative, the gallium scan was positive and subsequently proven to be correct by histological examination of the surgical specimen. The various difficulties encountered in interpreting gallium scans in the head and neck region are described. It is felt that by improved patient selection and special techniques the yield of positive cases can be improved and unsuspected extension of malignancy demonstrated. (auth)

20619 LINEAR GRAPH FOR DIGOXIN RADIOIMMUNOASSAY. Smith, S. E.; Richter, A. (St. Thomas' Hospital, London). J. Clin. Pathol.; 28: No. 10, 840-841(Oct 1975).

The determination of drug or hormone concentrations by radioimmunoassay involves interpolation of values for radioisotope counts within standard curves, a technique which requires some dexterity in curve drawing and which results in some inaccuracy in practice. In radioimmunoassays involving saturation of the antibody-binding sites a special case exists in that the bound radioactivity is directly proportional to the specific activity of the ligand in the system. Thus a graph of the ratio of radioactivity bound in the absence to that in the presence of added non-radioactive ligand is linear against the concentration of added ligand. A description is given of a simple and convenient modification of their method, and its application to the routine clinical determination of digoxin using a commercial kit. The linearity of the graphs obtained confirmed that binding of digoxin was approximately constant through the range of clinical concentrations tested (0.5 to 8ng/ml), although binding declined slightly at higher concentrations. (UK)

MATERIALS

20620 (BNL-20805) HEAT CAPACITY ANOMALIES ASSOCIATED WITH STRUCTURAL TRANSFORMATIONS IN beta-W AND PEROVSKITE COMPOUNDS. Viswanathan, R.; Ho, J. C. (Brookhaven National Lab., Upton, N. Y. (USA); Wichita State Univ., Kans. (USA)). 1975. 7p. (CONF-751212-5). Dep. NTIS $3.50.

From international conference on low lying lattice vibrational models and their relationship to superconductivity and ferroelectricity; San Juan, Puerto Rico (1 Dec 1975).

The similarity of the heat capacity anomalies, often observed with structural transformations driven by soft phonons, in both beta-W and perovskite compounds is discussed referring to recent work on V_3Si and $RbCaF_3$. (auth)

20621 (CNLM-6169) ADVANCED FUELS AND MATERIALS RESEARCH, FISCAL YEARS, 1965, 1966, 1967. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 9 Apr 1965. Contract AT(30-1)-2789. 38p. Dep. NTIS $4.00.

Declassified 9 Jan 1976.

Materials and topics being studied for advanced space nuclear power plants include structural alloys (Ti alloys), advanced fuels (UC, UN), Nb–Zr–C systems, alkali-metal corrosion, space radiators, and protective coatings. The subtask scopes are summarized together with progress in FY 1965 and expected results in FY 1966 and 1967. (DLC)

20622 INTERNAL FRICTION AND ULTRASONIC ATTENUATION IN CRYSTALLINE SOLIDS. Volume I. Proceedings of the Fifth International Conference Held at Aachen, Germany, August 27-30, 1973. Lenz, D.; Luecke, K. (Eds.). Berlin; Springer-Verlag (1975). 458p. (CONF-730844-P1).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973).

Forty-nine papers are presented under the following topics: phonons, electrons, and magnetic effects; point defects; and grain boundaries and phase transformations. Separate abstracts were prepared for 13 papers; ten other papers were previously abstracted as NSA 29: 03008, 03046, 03068, 03105, 10722, 13064, 13238, 16333, 24799, and 30148. (DLC)

For abstracts of individual papers see: 20762–20772, 20840, and 21539.

20623 INTERNAL FRICTION AND ULTRASONIC ATTENUATION IN CRYSTALLINE SOLIDS. Volume II. Proceedings of the Fifth International Conference Held at Aachen, Germany, August 27-30, 1973. Lenz, D.; Luecke, K. (eds.). Berlin; Springer-Verlag (1975). 524p. (CONF-730844-P2).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973).

Forty-five papers are presented under the following topics: interactions of dislocations with phonons and electrons, dislocation resonance and irradiation, cold work effects, and amplitude-dependent internal friction. Separate abstracts were prepared for 11 papers; ten other papers were previously abstracted as NSA 29: 03005, 03062, 03063, 03065, 03067, 10752, 10753, 16332, 16362, and 24798.

For abstracts of individual papers see: 20773–20775 and 20841–20847.

Ceramics and Cermets

Refer also to abstracts 19662, 19701, 20703, 20715, 20744, 20750–20752, 21250, 21982, 21999, 22042, 22104, 22130, 22133, 22134, 22220, 22289, 22302, 22587–22589, and 22672.

20624 (BNWL-B-463) CHARACTERIZATION AND EVALUATION OF MATERIALS FOR THE US-USSR MHD PROGRAM. Progress Report, July-September 1975. Bates, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. vp. Dep. NTIS $7.60.

Characterization of MHD insulator and electrode materials was initiated in support of the International US-USSR MHD Power Generation Program, U-02 Phase I. MgO insulators and five zirconia base electrodes containing CeO_2 and Y_2O_3 additions are being characterized. Characterization includes thermal diffusivity/conductivity, thermal expansion, composition and microstructure. The microstructural examinations were completed and thermal diffusivity of the electrodes and insulators were measured. 17 figures. (auth)

20625 (CEA-N-1824) ATOMIC DIFFUSION IN A PALLADIUM-SILICON AMORPHOUS ALLOY. Birac, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Sep 1975. 53p. (In French). Dep. NTIS (US Sales Only) $4.50.

Thesis. Submitted to Paris Univ., Orsay, France.

A study was made of the diffusion of ^{63}Ni and ^{6}Li in a $Pd_{80}Si_{20}$ amorphous alloy by means of a nondestructive tracer method. For the diffusion coefficient of Ni at 290°C, only an upper limit of 6×10^{-18} cm^2 s^{-1} could be obtained by counting the β activity of nickel. In the case of Li, tracks were registered of α particles due to the (n,α) reaction produced in a nuclear reactor. The diffusion coefficients are found to vary from $(0.2 \pm 0.1)\ 10^{-15}$ cm^2 s^{-1} to $(60.6 \pm 10)\ 10^{-15}$ cm^2 s^{-1} between 240 and 290°C. An activation energy does not exist, as in a crystalline solid, for the diffusion mechansim of Li in amorphous alloy $Pd_{80}Si_{20}$. (auth)

20626 (CNLM-4110) FORMATION OF A ZINC OXIDE COLUMBIUM PENTOXIDE SPINEL. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1961. Contract AT(30-1)-2789. 18p. Dep. NTIS $3.50.

The spinel $7ZnO \cdot Nb_2O_5$ ($Zn_7Nb_2O_{12}$ or $Zn_{2.33}Nb_{0.67}O_4$) was synthesized. The reactions occurring between ZnO and Nb_2O_5 were investigated as a function of temperature and composition. Evidence is presented to demonstrate the important role ZnO vapor played in formation of the spinel. It would appear that in the Nb_2O_5–ZnO system spinel formation was the last stage in a sequence of reactions in which the lowest symmetry oxide structure was formed first and the highest symmetry oxide, the cubic spinel, formed last. This reaction sequence agreed with Goldschmidt's oxide structure sequence proposed for the NiO–Nb_2O_5 and MgO–Nb_2O_5 systems. (auth)

20627 (CNLM-5177) SNAP-50 FUEL DEVELOPMENT, JANUARY–MARCH 1963. DeCrescente, M. A. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 21 May 1963. Contract AT(30-1)-2789. 16p. Dep. NTIS $3.50.

Declassified 3 Nov 1975.

Post-irradiation evaluation of UC and UN capsules and compatibility tests of UC with Nb–1 Zr and Li are reported. UC–ZrC compositions will be tested. (DLC)

20628 (CNLM-6025) POST-IRRADIATION EXAMINATION REPORT NDA CAPSULE 70. Owings, J. C.; Felber, F. F. Jr. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1964. Contract AT(30-1)-2789. 37p. Dep. NTIS $4.00.

Declassified 15 Dec 1975.

Results are presented of metallographic examination, μ isotopic, and fission gas analyses of Nb–UO_2 cermet fuels irradiated in an in-pile capsule. No evidence of centerline melting was observed. The cladding-core bonding was generally sound. Fuel swelling was observed at the ends of the fuel stack in three specimens. Radial and axial cracks were observed throughout the agglomerates. Although some individual cracks propagated through several agglomerates, the Nb network maintained continuity except where severe cracks occurred. The cladding exhibited an equiaxial grain structure (ASTM No. 7 & ASTM No. 8) except for the five mil inner diameter portion adjacent to the matrix. In specimens from 70-2 and 70-4 a 0.05 to 0.3 mil coating was observed on the OD of the cladding. The coating was identified as a niobium carbide and/or nitride by strain etching technique. Contact between the UO_2 agglomerate and surrounding Nb network was continuous. Hardness measurements taken on cladding of certain irradiated specimens revealed an average hardness of approximately 50 dph greater than clad hardness in control specimens. The ^{235}U fission burnups ranged from 17.81 to 20.42 at.%. A tabulation of uranium isotopic analysis and burnup results is given along with results of the fuel cover gas analysis. (JRD)

20629 (IS-T-702) HIGH TEMPERATURE VAPORIZATION AND THERMODYNAMIC STUDY OF THE SCANDIUM–SULFUR SYSTEM. Tuenge, R. T. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 196p. Dep. NTIS $7.50.

Thesis.

Results of studies on the stoichiometry, structure, vaporization behavior, and thermodynamic properties of the Sc–S system are reported. The thermodynamic results for the stability of ScS(s) are compared with reported results for other transition-metal and rare-earth monosulfides. Various models are discussed in regard to their ability to describe the bonding in these refractory solids. (JRD)

20630 (LA-tr-75-35) PREPARATION AND PROPERTIES OF TRANSITION METAL CARBIDES IN THEIR HOMOGENEITY RANGES. Samsonov, G. V.; Naumenko, V. I.; Okhremchuk, L. N. Translated by A. D. Cernick from Phys. Status Solidi (a); 6: 201-211(1971). 19p. Dep. NTIS $3.50.

An investigation is made of the technology of obtaining IV and V group transition metal carbides in the homogeneity range and of properties of these carbides such as lattice parameters, electrical resistivity, microhardness, thermal expansion coefficient, and electron work function. The concentration dependences of microhardness, electrical resistivity, work function, and thermal expansion coefficient of the titanium, zirconium, hafnium, and vanadium carbides are established to have practically linear character, but in the case of niobium and tantalum carbides the curves of the concentration dependence of these properties show extrema for the ratio C/Me similarly ordered 0.8 to 0.85. Changing of these properties in the homogeneity ranges are discussed in connection with the specific character of the electronic structures of the carbide phases investigated. (auth)

20631 PREPARATION AND PROPERTIES OF VO_2 THIN FILMS. Macialowicz, A.; Ignatowicz, S. A.; Kuzma, C.; Schmidt, B. Elektronika; 9: No. 16, 359-360(1975). (In Polish)

A method of obtaining VO_2 thin films is presented. V_2O_5 thin films were prepared by vacuum evaporation followed by reduction to VO_2 in an ammonia atmosphere. The temperature dependences of the resistance of VO_2 thin films were also measured. On the ground of these temperature characteristics, the magnitude of the resistance drop at the temperature of phase transition is designated. (auth)

20632 ELASTIC AND MECHANICAL PROPERTIES OF MOLYBDENUM–BORON ALLOYS. Kharitonov, V. I. pp 163-166 of Splavy Redk. Met. S Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

Elastic properties, determined by the resonance method and room-temperature mechanical properties of deformed alloys, were determined for electron-beam melted Mo–B alloys of two types, i.e., Mo with B ≤ 0.04% containing (i) C 0.003% and (ii) C 0.01%. The solubility of B in Mo in (i) was ~0.02% at 2000°C and 0.005% at 600, 800, and 900°C, while in (ii) it was ~0.012% at 2000°C and <0.005% at 1000°C. A minimum on the elastic-constant curves corresponded to the limiting solubility of β-rhombohedral B in Mo, and the increase after the minimum elastic and mechanical data the optimum composition with respect to ductility is Mo–0.002 to 0.005% B for (ii) and Mo–0.005 to 0.1% B for (i). (Metals Abstr.)

20633 SINTERED TOOL MATERIAL. Myerson, G. A.; Kiparisov, S. S.; Tret'yakov, V. I.; Panov, V. S.; Smirnova, M. M. USSR Patent 429,131. 23 Oct 1974. Filed Date 8 Dec 1971. vp.

A sintered tool material based on high speed steel is suggested, containing a refractory metal carbide. In order to increase the cutting properties and wear resistance, it includes a complex Nb–Ta carbide with the following relationship of components (vol. %): complex Nb–Ta carbide 1.5 to 6.0, Nb carbide 1.5 to 5.0, high speed steel–remainder. The invention relates to sintered materials for metal cutting tools, for example cutting blades, milling cutters and drills, for working of steel products and products of heat resistant alloys. (Ref. Zh.)

20634 THIN-FILM STUDIES OF EuH_2 AND YbH_2 AND OTHER RARE-EARTH METAL HYDRIDES. Curzon, A. E.; Singh, O. (Simon Fraser Univ., Burnaby, British Columbia). J. Phys., D (London); 8: No. 15, 1703-1708(21 Oct 1975).

Eu, Yb, Er, Dy, Ho, Tb, and Gd have been evaporated in H_2 gas, the pressure being from 0.03 to several torr. Er, Dy, Ho, Tb, and Gd reacted to form the cubic dihydrides and Yb reacted to produce orthorhombic YbH_2. The results for Eu depended on the H_2 pressure. It was found that Eu could not be evaporated at pressures above 2 torr because the metal fragmented into small particles when heated. In the range 0.2 to 2 torr diffuse-ring electron diffraction patterns were obtained. At 10^{-3} torr a sharp ring diffraction pattern consistent with orthorhombic EuH_2 was obtained. Oxides of the form M_2O_3 were observed, and they were less apparent in films grown in H_2 at the upper limit of the pressure range. These oxides also developed when films were heated by the electron beam of the microscope. Some diffraction patterns obtained from Eu and Yb contained evidence of the presence of the monoxides EuO and YbO. (auth)

20635 FEATURES IN THE CORROSION OF CARBIDES OF THE GROUP IV-VI TRANSITION METALS BY LASER BEAMS. Samsonov, G. V.; Verkhoturov, A. D.; Kovalenko, V. S.; Prikhod'ko, N. I.; Naumenko, V. Ya. Elektron. Obrab. Mater.; No. 2, 11-13(1975). (In Russian)

A SLS-10-1 (expansion unknown) laser source was used under the following conditions: radiation strength, 1000 volts; surface charge, 1.3×10^6 volts/cm^2; duration of the pulse, 0.0015 s; wavelength, 10,600 Å; focal length, 37 mm. Nine carbides were studied for which were given values of total C, free C, lattice dimension, porosity and microhardness. The carbides considered and their observed corrosion rates, given as Δ erosion × 10^{-6} g/mole, are as follows: TiC, 102.0; ZrC, 65.0; HfC, 9.0; VC, 55.0; NbC, 10.8; TaC, 9.0; Cr_3C_2, 3.0; Mo_2C, 4.5; and WC, 2.3. A monotonic relationship was not observed between the corrosion and the atomization energy. Transition metals of group IV have a higher electron donor capacity than those of groups V and VI. This results in a higher concentration of valence electrons at the carbon atom and this in a greater stabilization of the sp^3 configuration which should result in lower erosion rates. This effect, however, is offset by the greater rigidity of the Group IV metal carbides which explains the observed corrosion rates, i.e., Group IV > Group V ≳ Group VI. (JPRS)

20636 SOME CHARACTERISTICS OF THE BEHAVIOR OF REFRACTORY MATERIALS DURING MICROHARDNESS MEASUREMENTS. Pilyankevich, A. N.; Paderno, V. N. Fiz.-Khim. Mekh. Mater.; 11: No. 2, 60-65(1975). (In Russian)

The microhardness of refractory materials of the CaB_6 and LaB_6 types was studied in relation to the mode of testing employed. At first glance there appeared to be a marked increase in microhardness with decreasing load on the indentor used for the tests. However, analysis showed this to be only an apparent effect, attributable to local embrittlement and the generation of "rogue" cracks in the indentor impression. On correcting for these effects perfectly consistent results were obtained. No basic physical changes in microhardness with applied load were detected. Similar effects were predicted for other refractory materials. (Metals Abstr.)

20637 DC ELECTRICAL CONDUCTION IN THIN Ta_2O_5 FILMS. I. BULK-LIMITED CONDUCTION. Young, P.L. (Corning Glass Works, Research and Development Laboratories, Corning, New York 14830). J. Appl. Phys. 47: No. 1, 235-241 (Jan 1976).

Experimental measurements on the electrical conduction characteristic of thin Ta_2O_5 films are reported. The measured slope of the log (I) - $E^{1/2}$ plot corresponds well with the calculated Schottky slope for very thin films. However, by two independent tests it is shown that the conduction process cannot be electrode limited, even if interface states or other interface irregularities are postulated to exist. From measurements on heat-treated samples, transition from a modified Poole-Frenkel slope to a Poole-Frenkel slope is observed, thus providing direct evidence that conduction in Ta_2O_5 films is bulk limited. It is further shown that the presence of water in the film is a necessary ingredient for the occurrence of the modified Poole-Frenkel slope. (auth)

20638 DC ELECTRICAL CONDUCTION IN THIN Ta_2O_5 FILMS. II. HIGHLY IMPERFECT FILMS. Young, P.L. (Corning Glass Works, Corning, New York 14830). J. Appl. Phys. 47: No. 1, 242-247 (Jan 1976).

Experimental results on the dc conduction characteristics of highly imperfect Ta_2O_5 films are presented. Two regions with distinct conduction mechanisms have been identified. In the high-field region the conduction mechanism is bulk limited. In the low-voltage region the conduction mechanism is electrode limited and obeys a modified field-emission equation. Quantitative comparison between theory and experiment is possible. As a result, the nature of the Ta_2O_5-metal interface is identified. Based on reasonable estimates of the donor density and the effective mass of conduction electrons, the energy diagram of Ta_2O_5 can be deduced. There is also some experimental evidence which appears to be contradictory to the present interpretation. Plausible explanations for these discrepancies are discussed. (auth)

20639 COLORATION IN A WO_3 FILM. Hajimoto, Y.; Hara, T. (Central Research Laboratories, Canon Incorporated, 2-2-1 Nakane, Meguro-ku, Tokyo 152, Japan). Appl. Phys. Lett. 28: No. 4, 228-229 (15 Feb 1976).

The electrical coloration in WO_3 films in practical fabrication originates at the interface between WO_3 and CaF_2 and migrates towards the cathode. The rate of migration is higher than 1.4×10^{-9} cm^2/V sec. (auth)

20640 HELIUM BLISTERING OF CERAMIC COATINGS ON HASTELLOY X AND Nb–1% Zr. Kaminsky, M.; Das, S. K.; Ekern, R. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 165-166(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20641 HELIUM BUBBLES AT GRAIN BOUNDARIES OF HIGH-DENSITY $^{238}PuO_2$ SHARDS. McDonell, W. R. (Savannah River Lab., Lab., Aiken, SC); Sheehan, J. E.; Sisson, R. D. Trans. Am. Nucl. Soc.; 22: 214(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20642 RESIN-BASED PREPARATION OF HTGR FUELS: URANIUM LOADING DEVELOPMENT STUDIES. Haas, P. A. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 317-318(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20643 SURFACE COATINGS FOR SAVINGS IN ENGINEERING. Second Edition. Seminar Handbook. Cambridge, Eng.; Welding Institute (1974). 53p.

Methods of refractory coating deposition are reviewed. Information and discussions are included on oxyacetylene rod deposition, metallizing, sprayed coatings, fused coatings, arc spraying, plasma flame spraying, detonation plating, and furnace fusion. (JRD)

20644 KINETICS OF THE FORMATION AND STRUCTURE OF THE INTERMEDIATE PHASES IN THE INTERACTION OF SILICIDE AND BOROSILICIDE COATINGS WITH A MOLYBDENUM SUBSTRATE. Burykina, A. L.; Dzyadykevich, Yu. N.; Sosnovskii, L. A.; Epik, A. P.; Gorskii, V. V. Zashch. Pokrytiya Met.; No. 8, 54-58(1974). (In Russian).

The kinetic characteristics of the processes involved in the formation of intermediate phases as a result of the interaction of silicide and borosilicide coatings with a Mo substrate were studied at 1400 to 1600°C for 1 to 10 h in a vacuum; the structure of the resultant phases was also studied. In the silicide coating treated at 1600°C there was a complete transformation of $MoSi_2$ into the lower silicides Mo_3Si and Mo_5Si_3. In the borosilicide coating there was a partial transformation of $MoSi_2$ into Mo_5Si_3; at the boundary of the Mo_5Si_3 and MoB phases a new phase appeared, apparently $Mo_5(B,Si)_3$, which prevented further transformations. (Metals Abstr.)

20645 DETERMINATION OF PHASE BOUNDARIES AND THERMODYNAMIC PROPERTIES OF A METAL/GAS SYSTEM BY THE DECOMPOSITION PRESSURE TECHNIQUE. Sinha, V. K.; Singh, K. P. Trans. Indian Inst. Met.; 27: No. 5, 289-293(Oct 1974).

The design, operation, and performance of an apparatus capable of measuring equilibrium decomposition pressures of H in the Zr/H and Zr-2.5 wt.-% Nb/H systems are described, and the salient features discussed. (Metals Abstr.)

20646 DIELECTRIC PROPERTIES OF VACUUM-EVAPORATED FILMS OF TUNGSTEN OXIDE. Krishnaji (Univ. of Allahabad, India); Kant, P.; Srivastava, R. Thin Solid Films; 30: No. 2, 319-323(Dec 1975).

The dielectric constant of vacuum-evaporated films of tungsten oxide has been measured in the frequency range 300 Hz to 10 MHz at various temperatures (25 to 155°C) and with various thicknesses (300 to 5000 Å). The frequency response exhibits a dispersion region between 10 and 100 kHz at room temperature (~25°C) which shifts to higher frequencies as the temperature rises. The thickness dependence of the dielectric constant shows a rapid rise at low thicknesses but generally attains a saturation value at thicknesses at which the density of the films is seen to approach its bulk value. Electron diffraction patterns show that these films are stoichiometric, possibly due to the very slow rate of evaporation. The films have a dielectric strength of the order of 5.5×10^6 V cm^{-1}. (auth)

20647 OPTICAL PROPERTIES OF THIN FILMS OF TANTALUM PENTOXIDE AND ZIRCONIUM DIOXIDE. Khawaja, E. E.; Tomlin, S. G. (Univ. of Adelaide). Thin Solid Films; 30: No. 2, 361-369(Dec 1975).

The indices of refraction and absorption of thin films of tantalum pentoxide and zirconium dioxide have been determined in the wavelength range 250 to 2000 nm. These were obtained from the spectrophotometrically measured reflectance and transmittance of the films at normal incidence, using the method devised by Denton et al. The Ta_2O_5 films were amorphous and had smooth surfaces, and for these films analysis of the dependence of the absorption on photon energy has shown that there are band gaps of 4.15 and 4.51 eV. It is tentatively suggested that the observed absorption is due to direct transitions from a valence band with a spin-orbital splitting of 0.36 eV. The ZrO_2 films were polycrystalline with rough surfaces and had to be treated as double layer films in order to obtain continuous dispersion curves. They were effectively transparent over the spectral range covered. (auth)

20648 DIELECTRIC PROPERTIES OF FILMS PREPARED BY THE REACTIVE SPUTTERING OF Ta IN O_2/N_2 MIXTURES. Ingrey, S. J.; Westwood, W. D.; Maclaurin, B. K. (Bell-Northern Research, Ottawa). Thin Solid Films; 30: No. 2, 377-381(Dec 1975).

The dielectric properties of amorphous films prepared by reactively sputtering tantalum in oxygen-nitrogen mixtures have been measured. As the nitrogen content in the sputtering discharge was increased, the dielectric constant decreased from 26 to 16 and the films became more suitable for capacitor fabrication (i.e. had lower leakage currents and higher breakdown voltages). Comparison with reported results for anodic films indicates that the nitrogen concentration in the films reached approximately 7 at. % at the lowest dielectric constant. Sputtered tantalum films were found to be suitable for base electrodes, whereas aluminum electrodes significantly increased the capacitor leakage currents. (auth)

20649 EFFECT OF RARE EARTH OXIDE ADDITIONS ON THE STRUCTURE OF ZIRCONIUM AND HAFNIUM DIOXIDES. Vlasov, A. N.; Pal'guev, S. F. (Inst. of Electrochemistry, Sverdlovsk, USSR). Dokl. Akad. Nauk SSSR; 221: No. 2, 364-366(11 Mar 1975). (In Russian).

ZrO_2 and HfO_2 have three different modifications: a monoclinic stable to 1150 and 1950°C, a tetragonal stable to 1150 to 2300°C and 1950 to 2700°C, and a cubic fluorite stable above 2300 and 2700°C respectively. The monoclinic and tetragonal are distorted, cubic structures, and their formation is brought about by deviations from the crystallochemical criteria, in accordance with which the fluorite lattice is stable at a ratio of cation and anion radii $r_e/r_a > 0.732$. Since for ZrO_2 and HfO_2 $r_e/r_a \approx 0.66$, in order to convert the crystal lattice from monoclinic to tetragonal or cubic it is necessary to increase the distance between anions by a temperature expansion or by introducing an additive having a larger radius than Zr^{4+} or Hf^{4+} or to compress the lattice by applying external pressure. The purpose of this study is to establish criteria for the transition of a monoclinic lattice of ZrO_2 and HfO_2 to the tetragonal and cubic structures during dissolution of a rare earth oxide in the lattice according to the type of replacement with the formation of oxygen vacancies. The theory of thermodynamic similitude of the spacial arrangement of ions is used in developing the criteria for the transitions. The volumetric coefficient of expansion multiplied by the critical temperature is equated to the change in internal energy on dissolving one molecule of rare earth oxide. It was calculated that the approximate limit of the cubic region is at 5 to 8 mol % rare earth oxide, which value agrees well with experiment. In the ZrO_2 system, calculation gave a value of 12.5 mol % CeO_2. The experimental value is 13 mol % CeO_2. The volumes of the critical monoclinic cells at the critical points were approximately: $V(T) = 144.16$ Å^3 and $V(N) = 144.28$ Å^3. A similarity in the structures of the solid solutions along the concentration axis is observed at low temperatures and the pure ZrO_2 and HfO_2 along the temperature axis. (SJR)

20650 MECHANISM OF DIRECT PHASE CONVERSION OF CARBON AND BORON NITRIDE AT HIGH PRESSURES. Kurdyumov, A. V. (Inst. of Problem Materials, Kiev). Dokl. Akad. Nauk SSSR; 221: No. 2, 322-324(11 Mar 1975). (In Russian)

Under high pressures, the bonds in hexagonal layers of graphite and the graphite-like boron nitride BN(hex) can be deformed not only by "pure" compression, but also as a result of the displacement of atoms in directions normal to the layer plane, which leads to breakup of the layer. Two types of breakup are possible: corrugation of the layers (atoms 1, 3, 5 and 2, 4, 6 are shifted to opposite sides), and longitudinal bending (atoms 1, 4 and 2, 3, 5, 6 are shifted to opposite sides). It has been shown theoretically that deformation by longitudinal bending is a factor of three more likely from an energy point of view than is corrugation of layers, and both kinds of breakup are less likely than simple compression. With increasing pressure, however, the role of bond deformation by breakup of the layers rises. The graphite lattice can be converted to the cubic diamond phase by forming an intermediate structure of rhombohedral graphite, compression of the lattice along the c axis, and corrugation of the layers. The mechanism involves no diffusion of atoms. The conversion of BN(hex) to a sphalerite modification BN(sphal) can occur by the same mechanism, but requires a substantially higher activation energy, since formation of an intermediate rhombohedral structure of BN requires rotation of part of layers of the initial structure by 60°. Probably temperatures above 2500°C would be required. Conversion of BN(hex) to a wurstite modification BN(wurst) is observed at lower temperatures under conditions of static compression and with the application of shock waves. This conversion can occur without diffusion of atoms by a "corrugation" mechanism. It is shown that a hexagonal diamond phase, the crystallographic analogue of BN(wurst), cannot be formed from graphite by this mechanism. Longitudinal bending of graphite layers at high pressures makes it possible to explain the direct conversion of graphite to a hexagonal diamond phase. (SJR)

20651 Na_2SO_4 INDUCED ATTACK OF Ni–20Cr–2ThO_2. Davis, H. H.; Graham, H. C.; Uhlig, G. F. (Aerospace Research Labs., Wright-Patterson AFB, OH). pp 1014-1020 of Fifth International Congress on Metallic Corrosion. Houston, TX; National Association of Corrosion Engineers (1974).

From 5th international congress on metallic corrosion; Tokyo, Japan (21 May 1972).

The microstructural features of the reaction products formed during accelerated attack on Ni–20Cr–2ThO_2 in the presence of Na_2SO_4 are examined and related to the oxidation behavior of the alloy. A transient stage of accelerated attack occurs, corresponding to the growth of an NiO scale. Internal chromium sulfide particles are observed to be present in the alloy. Steady-state kinetics result from the formation of a Cr_2O_3 inner layer which controls the growth of additional oxide. (IAA) (auth)

20652 MOLECULAR DYNAMICS STUDY OF HYDROGEN DIFFUSION IN TANTALUM HYDRIDE. Jeulink, J. (Interuniversity Reactor Inst., Netherlands); De Graaf, L. A.; Caspers, L. M.; Ypma, M. R. Delft Prog. Rep., Ser. A; 1: No. 4, 115-119 (Oct 1975).

The method of molecular dynamics has been used to study the diffusion process of hydrogen in tantalum hydride in its—diluted—alpha-phase. This study was stimulated by the unexplainable differences between quasi-elastic neutron scattering data and the results of jump diffusion model calculations. Most computations have been made with a fixed metal lattice in which a hydrogen atom moves, obeying Newton's law. The effect of a moving lattice on the diffusion process was also studied. The forces were calculated using pair potentials. The diffusion process is found to be dominated by hydrogen atom jumps between interstitial sites of tetrahedral symmetry in the body-centered cubic lattice. Mean residence and jump times are obtained together with the velocity autocorrelation function and the self-diffusion coefficient. A remarkable correlation is found between successive jumps, in the sense that the hydrogen atom has the tendency to keep moving between the four tetrahedral sites in one plane and around an octahedral site. It is suggested that this behavior might well explain the closer fit of the neutron data for small momentum transfers to a model with jumps between octahedral sites. (auth)

20653 USE OF THERMOELECTRONIC EMISSION FOR STUDYING POINT DEFECTS IN REFRACTORY OXIDES. Rifflet, J. C. (CNRS, Orleans, France); Odier, P.; Anthony, A. M.; Loup, J. P. J. Am. Ceram. Soc.; 58: No. 11-12, 493-497(1975).

The thermoelectronic emission of refractory oxides in equilibrium with O_2 pressures from 10^{-6} to 10^{-11} atm at T greater than 1200°K is controlled not by chemisorption but by point defects present in the oxide. The effect of gases such as CO, CO_2, and N_2 was investigated. Analysis of the emission results for ZrO_2 and Y_2O_3, compared with their electrical conductivities, indicates the presence of anti-Frenkel disorder in these materials. Thus, high-temperature thermoelectronic emission as a function of O_2 pressure can be used to study point defects in refractory oxides. (auth)

20654 CONFIRMATION OF THE EXISTENCE OF DIFFERENT TYPES OF BONDS IN La_2O_3 BY ELECTRON SPIN RESONANCE OF Mn^{2+}. Bouysset, C. (Laboratory of the Physics of Solids, Toulouse); Escribe, C.; Bacquet, G.; Dugas, J.; Sibieude, F. Mater. Res. Bull.; 11: No. 1, 67-75(Jan 1976). (In French).

The E.S.R. spectra of Mn^{2+} in La_2O_3 single crystals were studied. A unique type of defect was observed. From the hyperfine coupling constant value it is deduced that this ion is covalently bounded to a number of oxygens lower than 7 which is the coordination number of the lanthanum site. These results are in agreement with the Caro's structural principle for A-type rare earth oxides. (auth)

20655 ENERGY TRANSFER FROM Ce^{3+} TO Tb^{3+} IONS IN $GdAlO_3$. Fava, J. (Univ. of Bordeaux, Talence, France); Le Flem, G.; Bourcet, J. C.; Gaume-Mahn, F. Mater. Res. Bull.; 11: No. 1, 1-9(Jan 1976). (In French).

Energy transfer from the Ce^{3+} to the Tb^{3+} ion has been studied in a host $GdAlO_3$ structure. The maximum fluorescence intensity of Tb^{3+} is observed for the composition $Gd_{0.96}Ce_{0.02}Tb_{0.02}AlO_3$. The energy transfer from Ce^{3+} to Tb^{3+} is explained by a dipole-dipole type coulombic interaction. (auth)

20656 SPUTTERED FILMS OF SUPERCONDUCTING TERNARY MOLYBDENUM SULFIDES. Banks, C. K.; Kammerdiner, L.; Luo, H. L. (Univ. of California, San Diego, La Jolla). J. Solid State Chem.; 15: No. 3, 271-273(Nov 1975).

The preparation of superconducting ternary molybdenum sulfide films of the formula M/sub x/Mo_2S_4, where M equals Pb, Sn, Cu, and Ag, by sputtering from a composite target is described. The transition temperatures of these films are 13.3, 11.0, 10.7, and 8.8°K, respectively. (auth)

20657 HOLE TRANSPORT IN MOS OXIDES. Hughes, R. C.; EerNisse, E. P.; Stein, H. J. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2227-2233(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Hole and electron transport are reported for three different kinds of MOS oxides: wet, dry, and ion-implanted. The electron-hole pairs are generated in the bulk of the oxide by a 3 ns x-ray pulse and the separation of the electron and hole photocurrents is made possible by the large difference in mobility. The electrons are so mobile that they are swept from the oxide (or trapped in a heavily ion-implanted region) during the x-ray pulse. The holes, on the other hand, have much lower mobilities which depend strongly on the preparation of the oxide. In the dry oxide the nominal mobility at room temperature is several orders of magnitude higher than in the wet oxide. The mobility is strongly activated by temperature in the oxides, and at liquid N_2 temperature no hole motion could be detected even though the electrons are still swept out. The low temperature charging of oxides can be understood in terms of the bulk trapped holes, but room temperature charging seems to be dominated by trapping close to the Si/SiO_2 interface rather than the transport of the holes from the bulk to the interface. Ion implantation provides electron traps which seem to be associated with the lattice damage rather than the ion. The electron traps can be successfully annealed out at 900°C in 20 minutes. (auth)

20658 FARADAY ROTATION NEAR THE CURIE POINT OF EuO. Huang, C. (Department of Physics and Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Ho, J.T. Phys. Rev. B 12: No. 11, 5255-5260 (1 Dec 1975).

The static magnetic properties of EuO near the Curie point have been measured using Faraday rotation. Comparison between magnetometer data reveals a small nonlinear term in the relation between rotation and magnetization. With this correction, our results yield critical parameters $\beta = 0.370 \pm 0.006$, $B = 1.10 \pm 0.04$, $\gamma = 1.30 \pm 0.02$, and $\Gamma = 0.397 \pm 0.012$. The value of γ agrees with other static experiments, but disagrees with neutron-scattering measurements and with theory. All the data can be scaled using these exponents, and are consistent with the two proposed parametric equations of state, with coefficients $a_1 = 2.56$, $k_1 = 1.025$ and $a_2 = 1.78$, $k_2 = 0.718$. Our data predict specific-heat parameters $\alpha = -0.04 \pm 0.03$ and $A/A' = 1.31 \pm 0.05$, in agreement with experimental results analyzed with nonsingular correction terms. (auth)

20659 SINTERING KINETICS OF YTTRIUM OXIDE. Mogilenskii, V. I.; Polonskii, Yu. A. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 218-222(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 261-265(Feb 1975).

An investigation of the sintering kinetics of yttrium oxide has shown that the phenomenological theory of sintering of metal powders can be used to describe compaction of pure oxides. On the basis of this theory the kinetic constants of initial oxide powders subjected to various different preliminary treatments were calculated and the correlation of the constants with the particle size of the materials was qualitatively established. The exponential dependence of the rate of decrease in pore volume on temperature was obtained, which greatly simplifies calculation of the powder constants and yields more accurate values of the activation energies of the accompanying processes, and values proportional to the imperfection concentration at the onset of sintering. (auth)

20660 PHASE DIAGRAM OF URANIUM–OXYGEN IN THE REGION OF COMPOSITIONS FROM $UO_{2.25}$ TO $UO_{2.67}$. Kozhina, I. I.; Shiryaeva, L. V. Sov. Radiochem. (Engl. Transl.); 16: No. 3, 361-363(1974).

Translated from Radiokhimiya: 16: No. 3, 360-363(1974).

Phase diagrams in the region of composition $UO_{2.25}$ to $UO_{2.67}$ was studied in order to resolve previously reported discrepancies. A revised version is presented. It is emphasized that only phases that are stable during repeated thermal cycling are presented. (JGB)

20661 NEW COMPOUNDS $A^{II}Sm B^{IV}NbO_7$ WITH THE PYROCHLORE(V) CRYSTAL STRUCTURE. Belyaev, I. N.; Shramova, A. G. (Rostov State Univ., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 226-228(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 269-272(Feb 1975).

Using the solid-phase reaction method, reactions were investigated at 800 to 1400°C in the systems ABO_3–$SmNbO_4$, where A is Ca, Sr, Ba, Pb, Cd, Zn, or Ni and B is Ti, Sn, Zr, Hf, or Ce. The formation was established of 16 new compounds with the formula $ASmBNbO_7$, where A is Pb or Cd, B is Ti, Sn, Zr, or Hf; A is Ca and B is Ti, Sn, Zr, or Hf; A is Sr and B is Sn, Zr, or Hf; A is Ba and B is Hf. (auth)

20662 BINARY TUNGSTATES AND MOLYBDATES OF CERTAIN ALKALI AND BIVALENT ELEMENTS. Efremov, V. A.; Trunov, V. K. (Moscow State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 229-232(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 273-277(Feb 1975).

Using x-ray phase and differential-thermal analysis, the products of reactions of tungstates and molybdates of Li and Na with molybdates and tungstates of Mg, Zn, and Cu were investigated. The unit-cell parameters and melting points of the compounds obtained have been determined. The group of compounds isostructural with $Li_2Fe_2(MoO_4)_3$ has been examined in detail. On the basis of data on this type of structure, an explanation is given for the deviation from stoichiometry in the case of binary molybdates $Na_{1.80}A_{2.10}(MoO_4)_3$, where A is Cu or Zn. (auth)

20663 REACTION MECHANISM OF SOLID-PHASE SYNTHESIS OF CERTAIN TUNGSTATES AND MOLYBDATES. Kononyuk, I. F.; Vashchuk, V. V.; Patsei, V. F. (Belorussian State Univ., Minsk). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 233-235(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 278-281(Feb 1975).

Propagation of reaction zones of WO_3 and MoO_3 in sintered tablets containing other oxides were microscopically examined. It was found that in reactions of solid-phase synthesis of tungstates and molybdates, the diffusion-mobile, covering reagent is usually the one with the lower melting point. The reaction does not involve the whole surface of the grains of covering reagent, but mainly that part which is adjacent to the covering reagent phase. Solid-phase synthesis of the tungstates of the alkaline earth metals involves unidirectional mass transfer of tungsten trioxide via its surface and boundary diffusion through a loose polycrystalline layer of reaction product. Kinetic models of solid-phase reactions in mixtures of powders are largely determined by the grain-size compositions of the reagents. (auth)

20664 PHYSICOCHEMICAL INVESTIGATION OF COMPOUNDS OF THE SYSTEM $B_2O_3-Fe_2O_3$. Zvereva, R. I.; Dukhovskaya, E. L.; Sapozhnikov, Yu. L. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 236-238(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 282-284(Feb 1975).

An investigation of the stability of $FeBO_3$ by means of thermographic and x-ray analysis has revealed that at 910 ± 10°C it begins to decompose into oxides of iron and boron, which react to form Fe_3BO_6 when left for prolonged periods at 910 to 975°C. The compound Fe_3BO_6 decomposes into the corresponding oxides at 975 ± 10°C. (auth)

20665 TEMPERATURE DEPENDENCE OF THE YOUNG'S MODULUS OF METALLINE CARBIDES. Bukatov, V. G.; Knyazev, V. I.; Korostin, O. S.; Baranov, V. M. (All-Union Scientific-Research Inst. of Hard Alloys, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 310-312(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 367-369(Feb 1975).

The temperature dependence of the Young's Moduli (E) of TiC, ZrC, VC, NbC, TaC, and WC were investigated at 20 to 2000°C. It was found that the temperature dependence of E is a nonlinear variation. The temperature dependence of the modulus defect ($\Delta E/E$) is represented by the exponential equation $\Delta E/E \sim \exp(-\Delta H/RT)$, where $\Delta E(T)$ is the deviation of the modulus E(T) from linearity, ΔH is the activation energy, T is the temperature, and R is the gas constant. (JRD)

20666 INTERNAL FRICTION OF $TaC_{0.99}$ FROM 20 TO 2000°C. Bukatov, V. G.; Korostin, O. S.; Knyazev, V. I. (All-Union Scientific-Research Inst. of Refractory Metals and Hard Alloys, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 313-315 (Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 370-372(Feb 1975).

The internal friction and Young's modulus of TaC were investigated at 20 to 2000°C. The activation energy of the Young's modulus (38 ± 1 kcal/mole) in TaC coincides with the formation heat. An observed modulus defect is attributed to formation of thermal vacancies in the carbide. The activation energy of the high-temperature background of internal friction was found to be 19 ± 1 kcal/mole. (JRD)

20667 ANISOTROPY OF THERMAL EXPANSION OF $HfTiIO_4$ AND ITS SOLID SOLUTIONS. Kocheregin, S. B.; Kuznetosov, A. K.; Tikhonov, P. A. (Inst. of Chemistry of Silicates, Leningrad). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 323-325(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 380-381(Feb 1975).

The thermal expansion of $HfTiO_4$ and its solid solutions in its principal crystallographic directions were investigated at 20 to 1000°C. Results show that $HfTiO_4$ undergoes polymorphic transitions and that solid solutions of this compound have a negative expansion coefficient and hysteresis typical of anisotropic substances. (JRD)

20668 BINARY MOLYBDATES AND TUNGSTATES OF THE COMPOSITION $M_5Bi(EO_4)_4$, WHERE M IS K OR Rb, E IS Mo OR W. Klevtsov, P. V.; Vinokurov, V. A. (Inst. of Organic Chemistry, Novosibirsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 331-332(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 387-388(Feb 1975).

The preparation and certain properties of bismuth-containing binary molybdates and tungstates with K and Rb of the composition $M_5Bi[Mo(W)O_4]_4$ are examined. The crystals were synthesized by crystallization from solutions in melts of alkali metal bimolybdates (bitungstates) under conditions of spontaneous nucleation. Binary molybdate compounds were also synthesized by sintering stoichiometric mixtures of the oxide components at 500 to 675°C for 10 days with repeated intermediate grinding. The synthesis process and the completion of the solid-phase reaction were monitored pyrometrically and by x-ray phase analysis. Resulting x-ray data are tabulated along with lattice constants, densities, and melting points. (JRD)

20669 THEORETICAL ANALYSIS OF THE REACTION OF ZIRCONIUM DIOXIDE WITH ZIRCONIUM CARBIDE. Granov, V. I.; Glazkov, A. V. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 187-190(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 226-229(Feb 1975).

On the basis of a theoretical analysis of the reaction of ZrC with ZrO_2, proposed by Fedorus, the formula of zirconium oxycarbide in terms of the chemical composition and quantitative ratio of the initial components was written and used in calculation of the maximum amounts of ZrC reacting with ZrO_2. The maximum amount of zirconium dioxide reacting with ZrC, and the boundaries of the region of homogeneity of zirconium oxycarbides, depend on the chemical compositions of the initial components. Formation of a second phase during the reaction of zirconium dioxide with ZrC is due to loss of carbon by zirconium carbide. (auth)

20670 X-RAY DIFFRACTION INVESTIGATION OF THE PHASES IN THE SYSTEM V–N. Arbuzov, M. P.; Khaenko, B. V.; Frenkel, O. A. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 196-200(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 236-241(Feb 1975).

The phase structure of the system V–N in preparations quenched and annealed at various temperatures, with nitrogen concentrations between 25 and 50 at.% are investigated. Results of x-ray-diffraction investigation of the system V–N, in the range of compositions from 25 to 50 at.% N, are used to refine the values of the temperature boundaries of the regions of homogeneity of the lower (β) and higher (δ) nitrides of vanadium and to study their real structures. The structure of the β phase is more complex than hexagonal close-packing. The arrangement of N and V atoms in the unit cells of these compounds are interpreted. (auth)

20671 PHASE COMPOSITION AND ELECTRICAL PROPERTIES OF THIN FILMS OF THE SYSTEM $Ta-Al_2O_3$. Osipov, K. A.; Borovich, T. L.; Galkin, B. D.; Miroshkina, E. M.; Urazaliev, U. S. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 208-210(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 250-252(Feb 1975).

The film structure was investigated by electron and x-ray diffraction on the same specimens used for measurements of the electrical properties. The content of amorphous and crystalline phases, the lattice constant of α-Ta (to within ± 0.005 Å), the scattering of the (110) texture axis of α-Ta, and the size of the coherent scattering regions of α-Ta and Al_2O_3 were determined. The resistivity of the films is 6.76 to 1.9×10^{-4} Ω/cm; the temperature coefficient of the resistance varies from -5.8×10^{-4} to 2.9×10^{-4} degrees^{-1} in the range 25 to 100°C. Films containing 50 to 98 at.% Ta, with a resisitivity of 1×10^{-2} to 2×10^{-4} Ω/cm and a temperature coefficient of the resistance equal to $\pm 2 \times 10^{-4}$ degrees^{-1}, can be used as resistor materials. (auth)

20672 EXOELECTRONIC EMISSION BY ANION-DEFECTIVE ZIRCONIUM DIOXIDE. Kortov, V. S.; Polezhaev, Yu. M.;

Gaprindashvili, A. I.; Shalyapin, A. L. (Ural Polytechnic Inst., Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 214-217(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 257-260(Feb 1975).

A study of the influence of vacancies in the oxygen sublattice of ZrO_2 on the parameters of exoelectronic emission is described, and aimed at elucidating the physical nature of the emission centers and estimating the possibility of using this method to determine the anion-defect contents of oxides. Results show that oxygen vacancies in ZrO_2 form emission-active F^+ centers. The intensity of the emission peaks depends on the concentration of anion defects, and their temperatures are determined by the structure of the oxide. The energy parameters of the electron traps, determined from measured values of the thermostimulated electron emission, are sensitive to the stresses in the oxide. The method of exoelectronic emission can be used to determine the anion defect content of ZrO_2, and to monitor changes in the stoichiometry of oxide films on metallic Zr during studies of corrosion processes. (auth)

20673 GAMMA-RAY ABSORPTOMETER FOR NUCLEAR FUEL EVALUATION. Ayer, J. E.; Schmitt, D. R. (Argonne National Lab., IL). Nucl. Technol.; 27: No. 3, 442-448(Nov 1975).

A gamma-ray absorptometer system used to determine the density distribution in nuclear fuel rods was designed, assembled, and operated. The absorptometer emits a collimated beam from an irradiated thulium source that is transmitted through a rotating fuel rod. The photons in the attenuated beam are counted and the counts are recorded on teletype tape. The tape output for each fuel rod inspected is used to punch counting data into card form. Data cards from a series of fuel rods are positioned in a FORTRAN-language source program. A computer then calculates and prints such information as the standard deviation due to counting and to density variations; the maximum, minimum, and average counts; and the density equivalent of each count. Calculated density is then programmed into an x-y plotter and displayed versus rod length. The system was found to be sensitive to changes of less than 1 percent of theoretical density with 95 percent confidence of detecting changes greater than 2 percent of theoretical. The design objectives of compactness, ease of operating, and amenability to use of modern computational techniques were achieved. (auth)

20674 ANISOTROPIC THERMAL EXPANSION OF BORON NITRIDE. I. Experimental Results and Their Analysis. Yates, B.; Overy, M. J.; Pirgon, O. (Salford Univ., Eng.). Philos. Mag.; 32: No. 4, 847-857(Oct 1975).

Interferometric measurements of the linear thermal expansion coefficients α_c and α_a in the c and a axial directions of well-oriented hexagonal pyrolytic boron nitride are reported between 80 and 780°K. The primary data for the direction parallel to the c-crystallographic axis yield smoothed results which are believed to be accurate to within 3% at 780°K, falling to 5% at 80°K. The corresponding figures for the direction perpendicular to the c-crystallographic axis are 9% at 780°K, passing smoothly through 3% at 230°K to 6% at 80°K. In association with earlier specific heat capacity results and provisional values for the elastic constants c_{13} and c_{33}, a Grueneisen parameter corresponding to the direction parallel to the c-crystallographic axis was calculated as a function of temperature. This parameter was applied to the determination of the temperature dependence of averaged reduced vibrational frequencies associated with this axial direction. The quasiharmonic approximation was applied to calculate the characteristic temperatures $\theta(n)$ corresponding to the maximum frequencies of the Debye distributions having the same nth order moments as the frequency of the vibrational spectrum L in the actual solid for $-3 \leq n \leq 6$. The geometric mean frequency of the vibrational spectrum correlates satisfactorily with infrared absorption data and all the thermodynamic quantities measured and calculated resemble the corresponding properties of pyrolytic graphite, with which hexagonal boron nitride shares a number of structural features. (auth)

20675 ANISOTROPIC THERMAL EXPANSION OF BORON NITRIDE. II. Interpretation by the Semi-continuum Model. Kelly, B. T. (UKAEA Reactor Group, Springfields). Philos. Mag.; 32: No. 4, 859-867(Oct 1975).

The semi-continuum model of the lattice dynamics of layer crystals devised for application to graphite is applied to hexagonal boron nitride. It is found that the thermal expansion coefficient λ_c parallel to the hexagonal axis is determined almost completely by the out-of-plane acoustic vibrational mode. The thermal expansion coefficient λ_a parallel to the basal planes is more difficult to understand, because the large negative component of the coefficient observed below 1000°K may be due entirely, or in part only, to the Poisson's ratio effect of the hexagonal axis expansion. Simple calculations of the interlayer forces are shown to be in reasonable agreement with experiment. (auth)

20676 HEAT CAPACITY AND ENTROPY OF TUNGSTEN CARBIDE. Andon, R. J. L.; Martin, J. F.; Mills, K. C. (National Physical Lab., Teddington, Eng.). J. Chem. Thermodyn.; 7: No. 11, 1079-1084(Nov 1975).

The heat capacity of tungsten carbide has been measured by adiabatic calorimetry from 14 to 348°K and by differential scanning calorimetry from 226 to 995°K. Thermodynamic properties to 1000°K of tungsten carbide have been computed from the heat capacities. The standard entropy of tungsten carbide at 298.15°K was found to be 32.10 J K^{-1} mol^{-1}. The results are compared with published values. (auth)

20677 DISTRIBUTION OF BORON IN THIN DIFFUSION LAYERS OF Si. Vigdorovich, V. N.; Zavodyan, A. V.; Orlov, P. B. (Moscow Inst. of Electronic Technique). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 688-690(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 802-805(May 1975).

The concentration profile of B in thin diffusion layers of Si obtained by diffusion from doped hydrolysis-polycondensation SiO_2 was established. This profile may be represented by a complementary error function with a derivation reliability of 95%. The surface of the diffusion layer in Si does not exhibit a sector with a constant impurity concentration or an impurity-depleted sector. It is postulated that the increase in the rate of diffusion is due to the concentration dependence of the coefficients of diffusion of the impurity both in the film and in Si. (auth)

20678 INTERACTIONS BETWEEN VANADIUM ATOMS IN THE SOLID SOLUTION $V_2O_3-Al_2O_3$. Bobrysheva, N. P.; Brach, B. Ya. (Leningrad State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 747-749(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 871-874(May 1975).

Phase transitions of $V_2O_3-Al_2O_3$ systems affecting electric conductivity and magnetic susceptibility were studied. It was found that the dependences of the magnetic susceptibility of the solid solutions $V_2O_3-Al_2O_3$ on composition and temperature agree with the postulated existence in them of V_2 quasi-molecules with fairly high interaction energies, which are probably formed without a change in the number of unpaired electrons on each vanadium atom involved in the bond. It is postulated that the phase transition in V_2O_3 at about 170°K is due to removal of strong exchange interactions between the vanadium atoms in the basal plane of the corundum structure. (auth)

20679 THERMODYNAMIC PROPERTIES OF THE OXIDES AND THE EQUILIBRIUM DIAGRAM OF THE Tb–O SYSTEM IN THE RANGE OF COMPOSITIONS $1.54 < O:Tb < 1.74$ AND TEMPERATURES 850 TO 1000°C. Vasil'eva, I. A.; Gerasimov, Ya. I.; Maiorova, A. F.; Pervova, I. V. (Moscow State Univ.). Dokl. Phys. Chem. (Engl. Transl.); 221: No. 4-6, 318-320(Apr 1975).

Translated from Dokl. Akad. Nauk SSSR; 221: No. 4, 865-867 (Apr 1975).

The nature and stability of the ordered intermediate phases in oxide systems were studied by the determination of the values of $\Delta\bar{G}_{O_2}$, $\Delta\bar{S}_{O_2}$, and $\Delta\bar{H}_{O_2}$ for the oxides in the Tb–O system in the composition range from $TbO_{1.543}$ to $TbO_{1.749}$ at temperatures from 850 to 1000°C. The data obtained was used to construct the equilibrium diagram of the Tb–O system. The studies were made by the emf method with the solid electrolyte $ZrO_2 \cdot YO_{1.5}$ in a cell with separated gas-electrode space. The results are tabulated and the equilibrium diagram is given. (JSR)

20680 STRUCTURE AND OPTICAL PROPERTIES OF OXIDIZED EuS FILMS. Palatnik, L. S.; Marincheva, V. E.; Naboka, M. N. (Kharkov Polytechnic Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 699-702(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 814-818(May 1975).

The changes in structure, optical properties, and electrical properties of EuS during annealing in air were investigated. It was found that europium monosulfide films are not oxidized when annealed in vacuum at 2×10^{-5} mm. During annealing in air, oxidation begins at ~300°C. In the initial stages of oxidation of EuS polycondensates a cubic oxysulfide phase of the composition Eu_2O_2S is formed; it has the Mn_2O_3 structure and a lattice constant of 12.28 Å, and is coherently linked with the matrix by EuS crystallites. Annealing of EuS films in air leads to formation of intermediate oxidation phases with a change in valence $Eu^{2+} \rightarrow Eu^{3+}$ in the following sequence: $EuS \rightarrow Eu_2O_2S_{cub} \rightarrow Eu_2O_2C_{hex} \rightarrow Eu_3O_4 \rightarrow Eu_2O_3$. The conductivity of the oxidized films has a semiconductive character. The change in the forbidden-band width, determined from the optical properties, during oxidation of the

EuS condensate corresponds to the gradual approach of the film composition to the end product of oxidation – Eu_2O_3. (auth)

20681 EFFECT OF THE DEGREE OF DISPERSION OF HfO_2 ON ITS REACTION WITH Ln_2O_3. Glushkova, V. B.; Krzhizhanovskaya, V. A.; D'yakovskii, V. S.; Abramova, V. M. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 828-829(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 964-965(May 1975).

The reactions of Ln_2O_3 with HfO_2 (where Ln = Nd, Dy, or Sm) were investigated. It was found that a decrease in particle size in the oxides decreases their reaction rates thus forming materials of higher refractoriness at temperatures several hundred degrees below the usual values. (JRD)

20682 ELECTRON FRACTOGRAPHY OF HEXABORIDES OF CERTAIN ALKALINE EARTH AND RARE EARTH METALS. Paderno, Yu. B.; Pilyankevich, A. N.; Paderno, V. N. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 733-735(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 856-858(May 1975).

An electron-microscopic investigation of the structure of the fracture surface of fused hexaborides of certain alkaline earth and rare earth metals has revealed that the brittleness of phases of the MB_6 type increases with the relative increase in the distances between the metal atoms, i.e., with an increase in the relative proportion of the B – B bond in these compounds. (auth)

20683 RADIATIVE PARAMAGNETIC AND OPTICAL ABSORPTION CENTERS IN GLASSES OF THE SYSTEMS $PbO-SiO_2$ AND $Na_2O-PbO-SiO_2$. Brekhovskikh, S. M.; Tyul'kin, V. A. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 792-796(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 927-932(May 1975).

Radiative paramagnetic and optical absorption centers in glasses of the system $Pb-SiO_2$ and $Na_2O-PbO-SiO_2$ with different PbO contents were investigated. It was found that all the Pb-containing glasses have a low radiative-optical stability and a high radiative paramagnetic stability. The optical absorption centers observed are diamagnetic. The paramagnetic centers are interstitial O^- ions. In nonalkali Pb – Si glasses the O^- ion is subjected to the effect of one or two Pb^{2+} ions, and in sodium lead silicate glasses it is under the influence of the weaker fields of one or two Na^+ ions. (auth)

Metals and Alloys

Refer also to abstract 20142.

20684 (CONF-751165-1) CONTRIBUTIONS TO THE RARE EARTHS TO SCIENCE AND TECHNOLOGY. Spedding, F. H. (Ames Lab., Iowa (USA)). 1975. 13p. Dep. NTIS $3.50.

From MS/ASM symposium on the effects of rare earths on the properties of metals and alloys; Cincinnati, Ohio, United States of America (USA) (13 Nov 1975).

This is a brief summary of some areas of science where the rare earths have already played an important role and of other areas where they are almost certain to be helpful. The discovery, abundance, separation, and properties of rare earths are discussed. It is pointed out that the rare earths comprise almost one-fourth of the known metals, and their alloys a third of the possible alloys. (DLC)

20685 SPECIALITY METALS. Chelius, J. Mach. Des.; 46: No. 4, 92-99(14 Feb 1975).

Physical properties, corrosion resistance, tensile properties, hardness, electrical resistivity and other properties are given for Ta, Nb, Mo, W, Be, Pt, Pd, Ir, Ru, Os, Rh, Ag, and Be. Forming methods such as stamping, drawing, welding, machining, punching, and brazing are discussed where applicable. (Metals Abstr.)

20686 PHYSICAL CONCEPTS OF PHASE TRANSFORMATIONS IN SHAPE-MEMORY ALLOYS. Apaev, B. A.; Voronenko, B. I. (Gorky Physicotechnical Research Inst., USSR). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 392-397(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 5, 28-33(May 1975).

Shape memory alloys may form not only reversible thermoelastic (thermal) martensite but also reversible mechanicoelastic martensite under stress. Mechanisms for the deformation and recovery are discussed. (33 references) (DLC)

20687 MICROSTRUCTURE AND PROPERTIES OF CARBURIZED HIGH-SPEED TOOLS. Bunin, K. P.; Ivanov, L. I.; Movchan, V. I.; Pedan, L. G. (Dnepropetrovsk Metallurgical Inst., USSR). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 455-457(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 6, 2-4(Jun 1975).

A study was made of carbide formation in carburized steels R12(12.1 W, 0.93 Mo, 3.3 Cr, 1.5 V, 0.32 Mn, 0.14 Si) and M8VF (2.3 W, 9.1 Mo, 3.9 Cr, 2.0 V, 0.16 Mn, 0.18 Si) with a low carbon content (0.24-0.28%). With increasing temperature and time, the carbide inclusions increase and are mainly of the M_6C type. The properties of the carburized layer are not inferior to those of standard high-speed steels. Commercial tests were made of carburized cutting tools of the two steels. (DLC)

Corrosion and Erosion

Refer also to abstracts 19662 and 19698.

20688 (BNWL-tr-163) OXYGEN SURFACE FILM FORMATION ON STEEL IN NEUTRAL SALTFREE WATER. Freier, R. K. 16 Dec 1975. Translation of pp 11-17 from VGB Feedwater Conference, Essen, Germany, 1969. 18p. Dep. NTIS $3.50.

The kinetics for the formation of oxide protective films on steel were studied. The results showed that even at room temperature the reaction of Fe with oxygen dissolved in water can be used to obtain magnetite films. The most favorable redox potential for the film deposition was determined and it was shown that the film growth can be controlled by oxygen consumption. There is a definite relationship between the dissolved Fe concentration, the redox potential, and the pH value and also between the Fe content and electrical conductivity in front of and behind the cation filter. (JSR)

20689 (CNLM-5690) PRELIMINARY PROPOSAL FOR MATERIAL EROSION SCREENING TESTS IN HIGH TEMPERATURE LIQUID METAL. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). [nd]. 13p. Dep. NTIS $3.50.

It is proposed that the presently available rotating disk apparatus be utilized to obtain erosion screening data on various refractory metal alloys in liquid metals of interest to the NASA. Basic advantages of this device are: (1) 18 material specimens are tested simultaneously; (2) material specimens are tested at three different wheel speeds for each test; (3) rapid change feature is incorporated in the design. Photographs and diagrams of the test equipment are included. (auth)

20690 (CNLM-5691) PRELIMINARY PROPOSAL FOR INVESTIGATIONS OF LIQUID METAL FILM BEARINGS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). [nd]. 18p. Dep. NTIS $3.50.

Proposals are presented aimed at establishing the design and use of hydrostatic and hydrodynamic bearings under operating conditions simulating space. In this program selected bearing configurations would be investigated in water to determine their performance and stability characteristics, and the more promising designs then investigated in high temperature liquid metal and finally, endurance run made on the most promising configuration. Existing facilities and hardware would be utilized wherever possible. (auth)

20691 (COO-2313-4) LIQUID LITHIUM CORROSION RESEARCH. Progress Report, April 1, 1975–December 31, 1975. Olson, D. L.; Bradley, W. L. (Colorado School of Mines, Golden (USA)). 1975. Contract E(11-1)-2313. 29p. Dep. NTIS $4.50.

Kinetics for grain boundary penetration and weight loss were determined for 304L stainless steel in Ti-gettered liquid Li. Empirical weight loss rate coefficient expressions were determined as function of both N content and temperature which predict the weight loss behavior of stainless steel for Li with high N content. Capillarity was eliminated as a possible driving force for grain boundary penetration of Fe by Li with the evidence of a grain boundary groove. Coupled ionic diffusion in a corrosion product surface film is suggested as the controlling mechanism for grain boundary grooving of Fe in N-contaminated liquid Li. Stress-enhanced grain boundary penetration showed that the penetration of stressed Fe is a function of t/sup $\frac{1}{3}$/ rather than t/sup $\frac{1}{2}$/, suggesting that primary creep of the Fe is continually breaking the protective corrosion product in the grain boundaries. A new purification procedure and systems were designed and constructed to achieve very low N contents in the liquid Li (less than 300 ppM N). A gas purification train, based on a molten Al bubbler for the removal of O and N, was designed and built, and vacuum melting of as-received Li and gettering are being initiated. Experiments designed to determine the role of Cr in stainless steel

resistance are in progress. Also experiments have been designed which will investigate how liquid metal corrosion is a function of the contact potential between the metals. (auth)

20692 (COO-2421-02) CORROSION, STRESS CORROSION CRACKING, AND ELECTROCHEMISTRY OF THE IRON AND NICKEL BASE ALLOYS IN CAUSTIC ENVIRONMENTS. Progress Report, 1 March 1975–29 February 1976. Staehle, R. W.; Agrawal, A. K. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering). 1976. Contract E(11-1)-2421. 87p. Dep. NTIS $5.00.

The stress corrosion cracking (SCC) of 304 stainless steel in caustic solutions can be prevented by the use of proper inhibitors. Sodium chromate was found to be an effective inhibitor for preventing the caustic stress corrosion cracking. Sodium chromate causes the corrosion potential of 304 stainless steel to shift from its active region into the passive region where the alloy is less susceptible to SCC. The threshold concentration of sodium chromate in the boiling saturated caustic solution is 0.005 molar. Molybdenum is a very unstable metal in aqueous caustic solutions at room temperature and above. It dissolves at a very fast rate and does not passivate. Nickel, out of the three metals chromium, iron and nickel, is the most stable metal in caustic solutions in the temperature range 150 to 290°C. The stability of iron base alloys decreases with an increase in either caustic concentration or temperature, increasing the nickel content in the alloys promotes corrosion resistance in caustic solutions. Molybdenum in fused caustic at 350°C under an argon blanketing atmosphere dissolves at a catastrophic rate. The metal dissolves in an active state without any passivation. Nickel, unlike molybdenum, exhibits an active-passive transition in fused caustic at 350°C under an argon blanket and also under a hydrogen blanket. However, the corrosion rate in the passive region may be of the order of 50 mils per year.

20693 (COO-2576-2) ELASTIC AND PLASTIC STRAINS AND THE STRESS CORROSION CRACKING OF AUSTENITIC STAINLESS STEELS. Progress Report, April 30, 1975–December 30, 1975. Troiano, A. R. (Case Western Reserve Univ., Cleveland, Ohio (USA)). Dec 1975. Contract E(11-1)-2576. 20p. Dep. NTIS $3.50.

Homogeneous deformation of type 310 austenitic stainless steel only slightly influenced the corrosion potential in a boiling 3 percent NaCl aqueous environment. The difference in a deaerated solution was of the order of 25 mV and somewhat more for an aerated solution. Elastic strains appeared to have little or no influence on the corrosion potential for fully annealed as well as 10 percent and 25 percent homogeneously deformed 310 steel. Oxygen in the environment shifted the corrosion potential several hundred millivolts in the less active direction. The critical cracking potential in a deaerated 3 percent NaCl solution was approximately the same for the annealed and homogeneously deformed specimens at approximately −125 mV SCE.

20694 (CRN-CNPA-75-15) MOESSBAUER STUDY OF ^{151}Eu IN HYDROGEN-LOADED PALLADIUM. Meyer, M.; Friedt, J. M.; Iannarella, L.; Danon, J. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires). 1975. 7p. Dep. NTIS (US Sales Only) $3.50.

The decrease of the ^{151}Eu isomer shift on hydrogenation of a dilute EuPd (2.5 at.% Eu) alloy is discussed in terms of the volume effect on the charge density at the nucleus. (auth)

20695 (DP-MS-76-10) INFLUENCE OF MICROSTRUCTURE ON STRESS CORROSION CRACKING OF MILD STEEL IN SYNTHETIC CAUSTIC-NITRATE NUCLEAR WASTE SOLUTION. Sarafian, P. G. (Georgia Inst. of Tech., Atlanta (USA)). Dec 1975. 113p. Dep. NTIS $5.50.

Thesis.

The influence of alloy microstructure on stress corrosion cracking of mild steel in caustic-nitrate synthetic nuclear waste solutions was studied. An evaluation was made of the effect of heat treatment on a representative material (ASTM A 516 Grade 70) used in the construction of high activity radioactive waste storage tanks at Savannah River Plant. Several different microstructures were tested for susceptibility to stress corrosion cracking. Precracked fracture specimens loaded in either constant load or constant crack opening displacement were exposed to a variety of caustic-nitrate and nitrate solutions. Results were correlated with the mechanical and corrosion properties of the microstructures. Crack velocity and crack arrest stress intensity were found to be related to the yield strength of the steel microstructures. Fractographic evidence indicated pH depletion and corrosive crack tip chemistry conditions even in highly caustic solutions. Experimental results were compatible with crack growth by a strain-assisted anodic dissolution mechanism; however, hydrogen embrittlement also was considered possible. (auth)

20696 (MDC-G-4442) REFRACTORY-ALLOY COMPATIBILITY WITH CURIA-244 AT 1800° AND 2000°C. Watrous, J. D.; Walker, J. C. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). Contract AT(45-1)-2138. 38p. Dep. NTIS $4.00.

Investigation of candidate refractory alloy compatibility with curium-244 sesquioxide at 1800 and 2000°C demonstrated containment capability for times in excess of a year. Refractory alloy composition (W, W-25Re, Mo, Mo-46Re, and W-30Mo-30Re), temperature at time (2000°C for 1000 and 10,000 h, and 1800°C for 12,000 h) were the three variables studied. The test specimens consisted of 0.25-g fuel pellets in contact with two polished metal discs, all in a thick-wall sealed pressure vessel container of the same alloy. Attack depths ranged from less than two mils for the best containers to greater than fifteen mils for the poorest containers. Observed modes of attack included surface roughening, by solution or corrosion mechanisms, and a combination of subsurface voids and precipitates, caused by helium injection, oxygen diffusion, and metallurgical instability. Significant amounts of both curia and container alloys mass-transported within the capsules. The curia structure was changed in appearance, presumably because of oxygen loss by permeation through container walls, particularly those rich in molybdenum. The test configuration and container oxygen permeability at the very high test temperatures are believed to have masked some experimental effects. Both Mo-46Re and W-30Mo-30Re exhibited two mils or less attack after 12,000 h at 1800°C. The Mo-46Re alloy also exhibited comparable behavior after 10,000 hr at 2000°C. Rhenium, based on short-term behavior at 2000°C, also appears to be a suitable container material. (auth)

20697 (ORNL/TM-4927) REVIEW OF LITHIUM IRON-BASE ALLOY CORROSION STUDIES. DeVan, J. H.; Selle, J. E.; Morris, A. E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 33p. Dep. NTIS $5.00.

An extensive literature search was conducted on the compatibility of ferrous alloys with lithium, with the emphasis on austenitic stainless steels. The information is summarized and is divided into two sections. The first section gives a brief summary and the second is an annotated bibliography. Comparisons of results are complicated by differences in lithium purity, alloy composition, alloy treatment, flow rates, and lithium handling procedures. For long-term application, austenitic stainless steels appear to be limited to about 500°C. While corrosion can probably not be decreased to zero, a considerable reduction to tolerable and predictable amounts appears possible. (auth)

20698 (PWAC-358) INTERNAL FRICTION STUDY OF OXYGEN AND NITROGEN INTERACTIONS WITH COLUMBIUM–ZIRCONIUM ALLOY. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 30 Jun 1961. Contract AT(30-1)-229. 21p. Dep. NTIS $3.50.

Mechanical relaxation measurements were performed on niobium–zirconium alloy specimens to obtain information on the position and movement of interstitial oxygen and nitrogen atoms. Results indicated that the position and movement of oxygen atoms were primarily limited to the vicinity of zirconium atoms when the oxygen concentration did not exceed 0.10%. At greater oxygen concentrations, the additional oxygen atoms were generally located in the vicinity of niobium atoms and exhibited an apparent diffusivity similar to that in unalloyed niobium. It was also found that the oxygen concentration influenced the position and movement of nitrogen interstitial atoms. An explanation of the role of zirconium in improving the lithium corrosion resistnace of niobium is suggested from this study. (auth)

20699 (TIM-842) POST-TEST EXAMINATION OF TYPE 316 STAINLESS STEEL PUMP IMPELLER RI 7C3. Woodward, C. E.; Potts, J. R.; Lymperes, C. J.; Schenck, G. F. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1965. 23p. Dep. NTIS $3.50.

A type 316 stainless steel impeller (RI 7C3) exhibited localized pitting damage when operated in 1400°F potassium under cavitating conditions. Evidence indicated that the mode of damage was predominantly mechanical. No evidence was found that corrosion by potassium played a role in the damage process. (auth)

20700 EFFECT OF RARE-EARTH ELEMENTS ON THE OXIDATION OF NICKEL–CHROMIUM ALLOYS. Abramova, N. B.; Ignatov, D. V.; Lazarev, E. M. pp 113-116 of Splavy Redk. Met. S Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

The kinetics of oxidation at 1000°C in air were studied for the alloys Ni–10% Cr, Ni–10% Cr–6% W, and Ni–10% Cr–6% Mo

with respect to the effect of additions of the rare-earth metals Y, La, and Ce. Phase-composition and scale-structure studies were also conducted. Such rare-earth additions can lower the oxidation rate. (Metals Abstr.)

20701 CORROSION RESISTANCE OF TYPE 316 STAINLESS STEEL TO Li_2BeF. Keiser, J. R.; DeVan, J. H. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 160(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20702 LITHIUM-STAINLESS STEEL CORROSION STUDIES. Selle, J. E.; DeVan, J. H. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 161(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20703 TENSIMETRIC, X-RAY, AND SEM STUDIES OF DEUTERON TRAPPING IN TITANIUM. Sheft, I.; Reis, A, H. Jr.; Gruen, D. M.; Peterson, S. W. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 166-168(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20704 TANTALUM ANODIC OXIDATION. III. Detailed Computation of Roughness Factor and Oxidation Potential Distribution. Attuati, F.; Cerofolini, G. F.; May, R. (Laboratorio Componenti Integrati, Milan). Thin Solid Films; 30: No. 2, 215-223(Dec 1975).
A model, previously proposed for the description of the anodic oxidation of a tantalum film in its first stages, is reconsidered and a detailed computation method is reported to calculate from experimental data the values of the parameters involved in the model. The films studied were β-tantalum and tantalum nitride sputtered onto various substrates, i.e. glazed alumina for β-tantalum, and glass and glazed, polished and as-fired alumina for tantalum nitride. All samples show the same qualitative behavior and for all films the energy heterogeneity and roughness variation during the anodization process have been computed. (auth)

20705 FATIGUE CRACK GROWTH IN SA508-CL2 STEEL IN A HIGH TEMPERATURE, HIGH PURITY WATER ENVIRONMENT. Gerber, T. L.; Heald, J. D.; Kiss, E. (General Electric Co., San Jose, CA). J. Eng. Mater. Technol.; 96: No. 4, 255-267(Oct 1974).
Fatigue crack growth tests were conducted with 1 in. plate specimens of SA508-CL2 steel in room temperature air, 550°F air and in a 550°F, high purity, water environment. Zero-tension load controlled tests were run at cyclic frequencies as low as 0.037 CPM. Results show that growth rates in the simulated Boiling Water Reactor (BWR) water environment are faster than growth rates observed in 550°F air and these rates are faster than the room temperature rate. In the BWR water environment, lowering the cyclic frequency from 0.37 to 0.037 CPM caused only a slight increase in the fatigue crack growth rate. All growth rates measured in these tests were below the upper bound design curve presented in Section XI of the ASME Code. (auth)

20706 INTERNATIONAL CONGRESS ON METALLIC CORROSION, FIFTH, TOKYO, JAPAN, MAY 21-27, 1972, PROCEEDINGS. Houston, TX; National Association of Corrosion Engineers (1974). 1152p. $75.00.
Theoretical and experimental studies are reported on corrosion processes in various aggressive media and on the behavior of passive films on different alloys, with particular reference to electrochemical processes involving anodic dissolution, corrosion cracking and fracture, inhibitors, and testings. Among the major topics discussed are the kinetics of iron dissolution and deposition; passive films formed on ferrous alloys; stress corrosion cracking of pure copper wire; infrared and electrochemical studies of acetylenic corrosion inhibitors; a new high-resistant organic coating on the basis of furfuryl alcohol; corrosion of steel piles driven in soil deposits; and a proposal of accelerated weathering tests. Separate abstracts are included for two papers. (IAA)

For abstracts of individual papers see: 20651 and 20707.

20707 STUDY OF ELECTROCHEMICAL BEHAVIOR OF MOLYBDENUM. Heumann, T.; Klimmeck, M. (Univ., Munich). pp 115-118 of Fifth International Congress on Metallic Corrosion, Houston, TX; National Association of Corrosion Engineers (1974).
From 5th international congress on metallic corrosion; Tokyo, Japan (21 May 1972).
Oxidation of molybdenum in nonaqueous electrolytes up to a lower oxidation state is investigated for the determination of the mechanism governing molybdenum dissolution. It is found that molybdenum goes into solution in the hexavalent state, and that molybdenum dissolution occurs in the active region (neighboring the region of hydrogen evolution) by three absorbed intermediates up to the oxidation state of three, whereby the single reactions appear to be quasi-irreversible. A possible dissolution mechanism is proposed which consists of a sequence of reactions including three electro-chemical and one chemical reaction. A mathematical treatment is given of the reactions involved. (IAA)

20708 HIGH TEMPERATURE INTERACTION BETWEEN MOLYBDENUM AND GRAPHITE. Matthews, R. B.; Jenkins, G. M. (Univ. College of Swansea, Eng.). J. Mater. Sci.; 10: No. 11, 1976-1990(Nov 1975).
Experiments were done on the interaction of molybdenum and graphite at temperatures between 2000 and 3000°C. The kinetics of the reaction were studied by a layer growth technique, perpendicular and parallel to the plane of deposition of a layered pyrocarbon. The variation of contact angle with temperature was measured optically. The behavior of Mo wire embedded in natural graphite powder was studied. The electron microprobe was used to determine diffusion of Mo in C and C in Mo. Electron scanning was shown to be a powerful tool for following the movement of Mo particles on graphite surfaces. A model and related mechanism are proposed to explain these results. Additional work is reported to compare the above behavior with the reaction of Mo with glassy carbon and other metals with pyrocarbon. (auth)

20709 REACTIONS OF Ti-Mo ALLOYS WITH BORON. Braun, S. M.; Rogozinskaya, A. A. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 736-738(May 1975).
Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 859-861(May 1975).
The behavior of Ti-Mo alloys at high temperatures in contact with active B-containing media was investigated. It was found that the velocity of the reaction depends on the ratio of the components in the alloy. The velocity is minimal when the alloys contain 10 to 20 at.% Mo. (JRD)

Preparation and Fabrication

Refer also to abstract 20873.

20710 (BARC-794) PREPARATION OF COPPER-BERYLLIUM ALLOYS FROM INDIAN BERYL. Paul, C. M.; Sharma, B. P.; Rao, K. S. S.; Rajadhyaksha, M. G.; Sundaram, C. V. (Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). 1975. 25p. Dep. NTIS (US Sales Only) $4.50.
Results of laboratory scale investigations are presented on the preparation of copper-beryllium and aluminum-beryllium master alloys using the fluoride process on Indian beryl as the basic material. The flowsheet involves (1) conversion of the Be-values in beryl into water soluble sodium beryllium fluoride, (2) preparation of beryllium hydroxide by alkali treatment of aqueous Na_2BeF_4, (3) conversion of $Be(OH)_2$ to $(NH_4)_2$ BeF_4 by treatment with NH_4HF_2, (4) thermal decomposition of $(NH_4)_2$ BeF_4 to BeF_2 and (5) magnesium reduction of BeF_2 (with the addition of copper/alluminum) to obtain beryllium alloys. The method has been employed for the preparation of Cu-Be master alloys containing about 8% Be and free of Mg on a 200 gm scale. An overall Be-recovery of about 80% has been achieved. Al-8% Be master alloys have also been prepared by this method. Toxicity and health hazards associated with Be are discussed and the steps taken to ensure safe handling of Be are described. (auth)

20711 (CNLM-641) FORM 180° BEND WITH FLAT TUBING. Goodin, L. F. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 24 Jan 1958. 9p. Dep. NTIS $3.50.
Flat stainless steel tubing, cut to a 23 inch length, was crimped in a vise on one end, inserted in a vibrating fixture, filled with silica sand 120 Grit and vibrated for two (2) minutes to insure a firm pack. The open end was then crimped and the tube placed in a curvit machine and formed. The formed tube was then cut to the required length and the sand removed by light tapping. Air was blown through the tube to assure that no sand or dust particles remained. (auth)

20712 (CNLM-3529) DEVELOPMENT FORMING TECHNIQUES TO FABRICATE HEAT EXCHANGER JACKETS: T-1025443, T-1025444, 1015782, AND 1015786. Interim Report. Barker, W. R. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1961. 12p. Dep. NTIS $3.50.
Research programs are reported on hydroforming, hydrospinning, hydraulic forming, and explosive forming for fabrication of heat exchanger jackets. These forming techniques were evaluated in fabrication of blank dimensions for AMS 5524 and Nb-1% Zr alloys. (JRD)

20713 (CNLM-4045) CATHODIC VACUUM ETCHING OF COLUMBIUM BASE ALLOYS. Niro, J. J. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 27 Jul 1962. Contract AT(30-1)-2789. 10p. Dep. NTIS $3.50.

A brief description is given of a cathodic vacuum etching technique used to etch Nb-base alloy specimens for metallographic examination. (auth)

20714 (CNLM-4304(Pt. 2)) TECHNICAL PROPOSAL FOR INVESTIGATION OF THE STRUCTURAL STABILITY OF WELDS IN TWO COLUMBIUM-BASE ALLOYS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 8 Nov 1962. 50p. Dep. NTIS $4.00.

A proposal for development of welding methods used in fabrication of refractory metal components of space vehicles is presented. Developmental approaches are discussed in sections on objectives, metallurgical considerations, fabrication considerations, service temperature considerations, alloy selection, and program organization. (JRD)

20715 (CNLM-5053) DISCUSSION OF SINTERING PROCESSES. Sturiale, T. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 May 1963. 19p. Dep. NTIS $3.50.

Aspects of sintering processes are discussed. Sintering phenomena are examined along with evaporation–condensation mechanisms, surface diffusion mechanisms, lattice diffusion mechanisms, material flow mechanisms, and grain growth. (JRD)

20716 (CNLM-5681) EVALUATION OF TUNGSTEN-LINED, COLUMBIUM–ZIRCONIUM ALLOY TUBING BY MEANS OF NONDESTRUCTIVE TESTING. McKie, R. H. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1964. Contract AT(30-1)-2789. 16p. Dep. NTIS $3.50.

Declassified 15 Dec 1975.

Development of methods for use in determining the ID coating thickness of vapor deposited W coating on Nb alloy tubing are described. As a result of ultrasonic, resonance thickness gage (vidigage), and x-ray examinations, it was determined that the tubing can be readily inspected nondestructively. By operating the ultrasonic resonance and ultrasonic pulse echo units simultaneously, it was possible to cross reference certain types of indications shown by both units, while the test was being conducted. Tubing discrepancies such as lack of physical bond between the coating and base metal, out of roundness, and internal defects were shown ultrasonically. Aggregate wall thickness was determined to within plus or minus 0.0005 inch by means of vidigage inspection. Variations in, or lack of tungsten deposit were shown radiographically as well as ultrasonically. (auth)

20717 (CNLM-5756) APPLICATION OF ELECTRON BEAM WELDING TO THE JOINING OF A THIN-WALL "J" PROBE TO A THIN-WALL ADAPTER. Rose, G. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 20 Jul 1964. Contract AT(30-1)-2789. 12p. Dep. NTIS $3.50.

Electron beam proves to be applicable to fillet welding a thin-wall tube to a thin-wall adapter. An initial investigation into applying electron beam welding to the joining of a thin-wall "J" probe to a thin-wall adapter is reported. (auth)

20718 (CNLM-6001) SPACE RADIATOR FABRICATION DEVELOPMENT FOR JULY–OCTOBER 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Dec 1964. Contract AT(30-1)-2789. 20p. Dep. NTIS $3.50.

Activities in programs conducted to evaluate compatibility of space radiator materials under simulated service conditions, develop joining methods for radiator assembly, evaluate strength of joints, and fabricate model radiator panels are reported. Compatibility tests were initiated to determine interdiffusion of potentially useful radiator materials as a function of time and temperature. Initial joining data was established. Grain coarsening characteristics were determined at braze temperatures. (auth)

20719 (CNLM-6076) SPACE RADIATOR FABRICATION DEVELOPMENT FOR NOVEMBER–DECEMBER 1964, JANUARY–FEBRUARY 1965. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 Apr 1965. Contract AT(30-1)-2789. 25p. Dep. NTIS $3.50.

Activities in programs conducted to evaluate compatibility of space radiator materials under simulated service conditions, develop joining methods for radiator assembly, evaluate strength of joints, and fabricate model radiator panels are reported. All 800-hour compatibility tests were completed. Compatibility couples containing beryllium as one of the materials were examined metallographically; only silver, molybdenum, vanadium, and tungsten showed reaction zones less than one mil in thickness after 800 hours at 760°C. Beryllium-niobium alloy and beryllium-stainless steel joints brazed with silver separated during aging test at 760°C for 800 hours. Compatibility tests were initiated on specimens joined by (1) diffusion bonding with silver foil at 760°C, (2) brazing with Ti–42.5 Mn alloy, and (3) brazing with four silver base alloys. (auth)

20720 (K–1869) EVALUATION OF VARIABLES WHICH AFFECT THE HARDNESS OF NICKEL PLATE DEPOSITED FROM WATTS-TYPE BATHS. Petit, G. S.; Wright, R. R.; Neff, W. A. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 21 Jan 1976. Contract W-7405-eng-26. 22p. Dep. NTIS $4.50.

In the course of the Cascade Improvement Program, many component equipment parts will be electroplated with nickel for corrosion protection. The maximum hardness which will be acceptable in the electroplated deposit is specified in Union Carbide's Job Specification JS-1396, Revision 3, entitled Electroplated Nickel Coatings on Steel Parts. The hardness specification is intended primarily as a control over both organic and inorganic impurities in the deposit. This report covers a study evaluating several of the numerous controllable variables which influence the hardness of the nickel plate deposited from a Watts-type bath. The variables tested were: 1) bath composition, 2) pH, 3) current density, 4) anode-cathode area ratio, and 5) bath temperature. Within the tested ranges of the variables studied, the pH and current density had the most influence on the plate hardness. The softest deposit was obtained with a bath pH of 1.5, a current density of 30 to 40 amperes/square foot, and with the anode-cathode area ratio in the range of 3:1 to 1:1. (auth)

20721 (SAND–75–8052) ELECTROPOLISHING OR CHEMICAL MILLING OF BERYLLIUM TO REMOVE MACHINING DEFECTS. Helms, J. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT(29-1)–789. 16p. Dep. NTIS $3.50.

The techniques of electropolishing and chemical milling to remove machine damage from beryllium are compared. Both techniques are found to be effective; chemical milling is recommended because it is easier to use and control. (auth)

20722 EFFECT OF THE DEOXIDATION OF STEEL WITH RARE-EARTH METALS ON THE QUALITY OF INVESTMENT CASTINGS. Slavgorodskii, N. D.; Zhadenov, L. A.; Suchkov, A. N. Liteinoe Proizvod.; 2: 38(Feb 1975). (In Russian)

Methods of reducing scrap due to blowholes by modifying the final deoxidation of alloy steels intended for agricultural castings are considered, especially by using rare-earth metals (REM), in the form of alloys containing Si 40 to 50, Fe 30 to 40, and REM 20 to 22%, in addition to normal Al deoxidation. The form of the non-metallic inclusions in the structure was greatly improved; instead of being acicular they assumed a globular form. Complex deoxidation of the steel with 0.2% Al and 0.2% of the REM alloy sharply improved the mechanical properties and reduced scrap due to blowholes by 3 to 4 times. (Metals Abstr.)

20723 MECHANISMS OF THE FORMATION OF A DIFFUSION LAYER [CHROMIZING OF MOLYBDENUM]. Mulyakaev, L. M. Zashch. Pokrytiya Met.; 8: 12-17(1974). (In Russian)

The mechanism of the formation of a diffusion layer during diffusion coating is discussed, taking as an example the chromizing of Mo by means of a powder mixture containing Cr 70, Al_2O_3 25, and NH_4Cl 5%. The mechanism is determined not only by diffusion of the coating element into the substrate but also by the diffusion of atoms from the parent metal (Mo) in the opposite direction; the ratio between the rates of these two flows has a major effect on the diffusion mechanism. If atoms of the diffusion element are generated directly from the coating medium, the layer experiences extra growth by virtue of the direct deposition of these atoms on the surface being coated. The nautre of the intermetallic compounds formed cannot always be ascertained from the equilibrium phase diagram of the system. (Metals Abstr.)

20724 SILICIDING NIOBIUM IN A GLOW DISCHARGE. Prokoshkin, D. A.; Tarapata, V. V.; Vasil'ev, A. I. Zashch. Pokrytiya Met.; 8: 49-54(1974). (In Russian)

The laws governing the siliciding of Nb in a glow discharge were studied, special attention being paid to the structure of the diffusion layers. The growth of these diffusion layers during the siliciding of Nb in a $Si-SiCl_4$ atmosphere constituted a combination of several processes: (i) the formation of silicide layers of the $NbSi_2$, NbSi, and Nb_5Si_3 types of interaction between Nb and SiCl, $SiCl_2$, and $SiCl_3$; (ii) the release of Si into the gaseous phase by an interaction between $NbSi_2$ and $SiCl_4$; and (iii) the removal of part of the silicide layers as a result of cathodic sputtering of the surface. (Metals Abstr.)

20725 EFFECT OF THE COMPOSITION AND STATE OF THE GASEOUS MEDIUM ON DIFFUSION-COATING PROCESSES IN METALS. Arsamasov, B. N.; Prokoshkin, D. A.; Bul, N. K.; Glushchenko, V. N. Zashch. Pokrytiya Met.; 8: 17-20(1974). (In Russian)

The chief characteristics of the processes involved in the diffusion coating of metals by the circulation technique in a gaseous medium are outlined. Specific examples are given for the coating of Mo surfaces with Si or Al from $SiCl_4$ and $AlCl_3$ atmospheres. The reactions may take place in several stages, e.g., $SiCl_4$ is first reduced to $SiCl_2$. The advantage of the method is that a number of parameters such as temperature and pressure may be varied in order to control the process, and highly protective surface coatings may be obtained. (Metals Abstr.)

20726 A LOW-TEMPERATURE SOURCE FOR THE GENERATION OF URANIUM VAPOR. Lee, H.U.; Zare, R.N. (Department of Chemistry, Columbia University, New York, New York 10027). J. Chem. Phys. 64: No. 1, 431-432 (1 Jan 1976).

Uranium is a highly refractory metal, boiling at 4135 °K and having a vapor pressure of 1 torr at 2729 °K. At these elevated temperatures, the corrosiveness of uranium poses severe materials problems in its vaporization. An alternative approach for the production of uranium atoms is to make a volatile chemical derivative of uranium and then to find a simple means of reducing this compound to elemental uranium in the gas phase. The generation of uranium vapor from the dissociation of uranocene by collisions with metastable argon atoms is reported. (AIP)

20727 DIFFUSION CHROMIZING OF METALS IN AN IODIDE MEDIUM BY THE CIRCULATION METHOD. Arzamasov, B. N.; Pimenova, L. A. Zashch. Pokrytiya Met.; No. 8, 79-83(1974). (In Russian)

The diffusion chromizing of metals in an iodide medium by the circulation method is analyzed theoretically and experimentally. The interaction of Cr with various halides is analyzed thermodynamically. An iodide solution is shown to be the best medium for the diffusion chromizing of metals and alloys. The mechanism of the chromizing of Fe and Mo by the circulation process is examined in detail. The process is extremely efficient for both these metals. (Metals Abstr.)

20728 LAWS GOVERNING THE FORMATION OF A STRENGTHENED LAYER IN THE ELECTRIC-SPARK ALLOYING OF IRON AND STEEL WITH TRANSITION METALS. Samsonov, G. V.; Verkhoturov, A. D.; Bovkum, G. A. Zashch. Pokrytiya Met.; No. 8, 21-23(1974). (In Russian)

Laws governing the formation of hardened (strengthened) layers on the surface of Armco iron and C steels as a result of electric-spark alloying these materials with transition metals such as Ti, Zr, Ta, V, and Hf are discussed with reference to experimental investigations by x-ray and electron diffraction, x-ray microanalysis, microhardness measurements, metallographic analysis, and measurements of the electrical resistance, as well as spectral analysis. The thickness of the hardened "white" surface layer, its density, and the quality of its adhesion to the substrate are determined by the nature of the anode material and the type of interaction occurring between anode and cathode, the type of intermetallic compound created, which in turn is related to the electronic structure of the alloying element. (Metals Abstr.)

20729 SUB-VERTING NUCLEAR REACTOR VESSELS. Weld. Des. Fabr.; 48: No. 4, 120-122(Apr 1975).

Stainless 304L plate $2\frac{3}{4}$ in. thick for a Na-cooled 350 ton nuclear reactor vessel is Sub-Vert welded for tight, defect-free welds. Sub-Vert welding is submerged arc vertical welding, in a narrow groove 65 percent of conventional width, by depositing successive weld passes through the thickness of the plate with the bead axis perpendicular to the joint axis, by the welding head oscillating as it crawls vertically up the bead. The reactor is for the Hanford Fast Flux Test Facility, a 400 MW (thermal) fast neutron irradiation test plant. The welds must withstand the liquid Na temperature of 1100°F and prevent the highly reactive Na from contacting water in the heat exchangers. (Metals Abstr.)

Properties, Structure, and Phase Studies

Refer also to abstracts 19658, 19701, 19960, 20107, 20874, 21546, 21547, 22093, 22105, 22119, 22120, 22227, and 22305.

20730 (AECL-5231) YOUNG'S MODULUS OF CRYSTAL BAR ZIRCONIUM AND ZIRCONIUM ALLOYS (ZIRCALOY-2, ZIRCALOY-4, ZIRCONIUM-2.5 WT % NIOBIUM) TO 1000K. Rosinger, H. E.; Ritchie, I. G.; Shillinglaw, A. J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1975. 25p. Dep. NTIS (US Sales Only) $3.50. AECL $1.00.

This report contains experimentally determined data on the dynamic elastic moduli of Zircaloy-2, Zircaloy-4, zirconium-2.5 wt% niobium and Marz grade crystal bar zirconium. Data on both the dynamic Young's moduli and shear moduli of the alloys were measured at room temperature and young's modulus as a function of temperature was determined over the temperature range 300 to 1000°K. In every case, Young's modulus decreases linearly with increasing temperature and is expressed by an empirical equation fitted to the data. Differences in Young's modulus values determined from specimens with longitudinal axes parallel and perpendicular to the rolling direction are small, as are the differences between Young's moduli determined from strip, bar stock, and fuel sheathing. (auth)

20731 (AECL-5256, pp 47-48) MAGNETISM AND CENTRAL MODES IN Pr. Buyers, W. J. L.; Lebech, B. Oct 1975.

In Physics Division progress report, July 1 to September 30, 1975.

20732 (BNL-20736) FORMATION OF A-15 Nb_3Ge BY ELECTRON BEAM CO-DEPOSITION. Lutz, H.; Wiesmann, H.; Bashkirov, Y. A.; Kammerer, O. F.; Strongin, M.; Warren, G.; Roche, J.; Douglass, D. H. (Rochester Univ., N. Y. (USA)). 1975. 7p. (CONF-751212-6). Dep. NTIS $3.50.

From international conference on low lying lattice vibrational models and their relationship to superconductivity and ferroelectricity; San Juan, Puerto Rico (1 Dec 1975).

The superconducting transition temperature of Nb_3Ge prepared by electron beam deposition onto heated substrates has been investigated as a function of evaporation rate, substrate temperature, and composition. Results are compared with previous investigations. (auth)

20733 (CALT-820-80) TREND OF SUPERCONDUCTIVITY IN AMORPHOUS SUPERCONDUCTING TRANSITION METALS AND THEIR ALLOYS. Poon, S. J. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Dec 1975. Contract AT(04-3)-822. 21p. Dep. NTIS $3.50.

A plausible interpretation for the trend of superconducting transition temperature T/sub c/ in amorphous transition metal TM alloys is presented from a chemical point of view. It is shown that the T/sub c/ behavior is not a reflection of the dependence of the atomic parameter eta on the number of electrons per atom, but rather due to two other effects. One is the changes in the density of states due to the mixing of antibonding and bonding states in the bcc amorphous metals. The other is an increase in the number of valence d electrons participating in the phonon-induced d-d coupling towards the mid series. (auth)

20734 (CEA-R-4692) STUDY OF CAVITATION DURING CREEP OF MAGNESIUM ALLOYS. Henckes-Viatte, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Dec 1975. 153p. (In French). Dep. NTIS (US Sales Only) $6.75.

Thesis. Submitted to Univ., Paris.

Nucleation and growth of intergranular cavities during tensile creep of magnesium base alloys, especially a MgAlSi alloy with 0.8% aluminium and 0.2% silicon, were investigated. Cavities have been found to nucleate preferentially on precipitates. Their number follows a nearly linear law in function of time and elongation. The cavity nucleation model suggested by Smith and Barnby, by grain boundary sliding with precipitates acting as barriers, explains best the experimental results. Cavity growth during the major part of tensile creep tests performed at 350°C, can be accounted for by Hull and Rimmer's grain boundary diffusion model, modified so as to include continuous cavity nucleation. At the end of the tertiary creep stage, other mechanisms such as plastic instability as well as mechanical growth seem to be operating. Cavities observed in areas denuded of precipitates formed during high temperature creep in a hydrided MgZr alloy have also been investigated. Nucleation and growth of these cavities explain by mechanisms similar to the above ones. (auth)

20735 (CEA-R-4720) SELF-DIFFUSION IN CONCENTRATED IRON-PALLADIUM ALLOYS. Filion, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Dec 1975. 139p. (In French). Dep. NTIS (US Sales Only) $6.00.

Thesis. Submitted to Paris Univ., Orsay, France.

Measurements of the diffusion coefficients of ^{59}Fe and ^{103}Pd in various iron-palladium alloys (0 to 100 at.% iron) between 1,100 and 1,250°C, showed that the activation energies for self-diffusion for the two tracers are practically equal, independent of composition, and very close to those for chemical diffusion. This result is in good agreement with the fact that the thermodynamic activities of iron and palladium have a small temperature

dependence and that the vacancy flow, as calculated with the model of Manning, is rather small. In spite of a strong ordering tendency in the solid solution of Fe–Pd, as indicated by a thermodynamic calculation, this model allows one to calculate, with the aid of the measured self-diffusion coefficients, various parameters, such as the correlation factors for both iron and palladium, the vacancy correlation factors, and the atomic jump frequencies. From a theoretical point of view, the model of Manning allows a reduction to 3 independent phenomenological coefficients, quantities which are alternately obtained as a result of self-diffusion in various alloys as a function of temperature. (auth)

20736 (CNLM-1690) CHANGING THE HYDROSPIN H. E. TUBE HEADERS FLANGES GRAIN STRUCTURE FROM RADIAL TO AXIAL. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 17 Apr 1959. 6p. Dep. NTIS $3.50.

The desired change in grain structure was realized after the blanks were fully annealed and spun with a 40% reduction in wall thickness. (auth)

20737 (CNLM-3714) PROPOSAL FOR CONTINUATION OF AN INVESTIGATION OF THE WORK HARDENING BEHAVIOR OF BODY CENTERED CUBIC REFRACTORY METALS. Schmickrath, B. A. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jun 1961. 20p. Dep. NTIS $3.50.

Proposed research on high purity W tensile properties is outlined. This work is proposed because W has a large Gb value where G is shear modulus and b is Burgers vector. It is noted that Mo and Ta, with intermediate values of Gb, may also be studied if there appears to be a correlation of work hardening with Gb. Suggested experimental work to evaluate mechanisms of work hardening in several bcc materials is summarized. (JRD)

20738 (CNLM-3813) RESEARCH FOR A FUNDAMENTAL STUDY ON THE WORK HARDENING OF BODY CENTERED CUBIC METALS. Progress Report of Bi-Monthly Period June 19–August 18, 1961. Gregory, D. P.; Rowe, G. H.; Stroh, A. N. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1961. Contract AF 33(616)-7855. 32p. Dep. NTIS $4.00.

Research aimed at gaining an understanding of work hardening mechanism in bcc metals is summarized. A work hardening mechanism, whose details are as yet incomplete, has been suggested from results of strain rate cycling tests, temperature cycling tests, and transmission microscopy on pure polycrystalline Nb of nominal interstitial element content. All tests were conducted in the temperature range 0 to 100°C. (auth)

20739 (CNLM-3895) RESEARCH FOR A FUNDAMENTAL STUDY ON THE WORK HARDENING OF BODY CENTERED CUBIC METALS. Progress Report for Bi-monthly Period, August 19–October 18, 1961. Gregory, D. P.; Rowe, G. H.; Stroh, A. N. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 16 Nov 1961. Contract AF33(616)-7855. 29p. Dep. NTIS $4.00.

Research aimed at gaining an understanding of work hardening mechanisms in bcc metals is summarized. Experimental results indicate that the density of dislocations formed during deformation at −78 and −196°C is higher than that formed during room temperature deformation and that the density formed during deformation at 500°C is lower. The variation in activation volume between specimens of the same heat of material and between specimens from different heats of material of the same nominal purity was studied. (auth)

20740 (CNLM-5719) LINEAR THERMAL EXPANSION OF TWO IRON–MOLYBDENUM AND FIVE NICKEL–MOLYBDENUM ALLOYS FROM 68 TO 1700 TO 68°F. Harrington, L. C.; Rowe, G. H. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 18 Apr 1966. 29p. Dep. NTIS $4.00.

Fe-base Mo, and Ni-base Mo alloys, were studied along with Hastelloy B and Hastelloy W which were included for comparison. The specimens were heated for ½ to 1 hour at 2100 to 2200°F and then either: cooled rapidly in the water-jacketed zone outside the furnace (treatment A), or cooled slowly in the furnace (treatment B). After heat treatment (A) all materials except Ni + 20% Mo showed a permanent contraction after expansion measurements made for the temperature cycle 68–1700–68°F. For heat treatment (B) none of these alloys showed a permanent length change after 68–1700–68°F dilatometer measurements. The two nickel alloys containing 25 or 30% molybdenum showed a reversible phase change during the dilatometer cycle when the specimens had been given heat treatment (B). Photomicrographs and hardness data for the Ni + 30 Mo alloy show that rapid cooling from 2100°F favors a relatively soft, single phase equiaxed grain structure (α_{Ni}), while slow cooling enhances intergranular precipitation of β and γ phases and a hardening of the α_{Ni} matrix. (auth)

20741 (COO-2296-10) DIFFUSIONAL CREEP OR MULTICOMPONENT SYSTEMS. Progress Report, February 1, 1975–January 31, 1976. Li, J. C. M. (Rochester Univ., N. Y. (USA). Dept. of Mechanical and Aerospace Sciences). 1976. Contract E(11-1)-2296. 45p. Dep. NTIS $4.00.

Hydrogen embrittlement was studied from the viewpoint of the interaction of hydrogen with the stress field of particles. The interaction between dislocation loops was studied to include shear components of the Burgers vector. It turned out that this additional component could stabilize both the cuboidal arrangement and the stair-step configuration of square dislocation loops. These results were used to explain certain precipitation morphologies. Equipment improvements are reported. The only creep results obtained so far were the temperature and stress dependences of penetration velocity on a beta-tin single crystal, and the stress dependences of lead and succinonitrile polycrystals. They agree with literature data. (DLC)

20742 (COO-2314-9) EXPERIMENTAL DETERMINATION OF THE TEMPERATURE DEPENDENCE OF METALLIC WORK FUNCTIONS AT LOW TEMPERATURES. Progress Report, March 1, 1975–February 9, 1976. Pipes, P. B. (Dartmouth Coll., Hanover, N. H. (USA). Dept. of Physics and Astronomy). 1976. Contract E(11-1)-2314. 10p. Dep. NTIS $3.50.

Progress described includes measurements of the temperature dependence of the work functions for niobium and aluminum between 2 and 20°K and the development of a simple theoretical model to explain the effects of adsorbed ^{4}He gas on the temperature dependence of the work function in niobium. (auth)

20743 (LBL-4148) THERMODYNAMIC AND KINETIC STUDIES OF SOME GROUP III AND GROUP V ELEMENTS AND ALLOYS BY SOLID STATE ELECTROCHEMICAL TECHNIQUES. Anderson, T. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 182p. Dep. NTIS $7.50.

Thesis.

The Gibbs free energy of forming gallium sesquioxide and indium sesquioxide are measured using a CO_2–CO–O_2 gas reference electrode and calcia stabilized zirconia as the solid electrolyte. The free energies are: DELTA G°/sub f/(beta-Ga_2O_3(c)) equals −(265,209 +- 152) + (82,47 +- 0,16) (T/K) cal mol^{-1} and DELTA G°/sub f/(In_2O_3 (c)) equals −(223,160 +- 137) + (79,47 +- 0,12) (T/K) cal mol^{-1}. Measured absolute free energies of formation of In_2O_3 and beta-Ga_2O_3 are in excellent agreement with previous studies though discrepancies are found in the standard entropy and enthalpy changes. Comparison is made to available calorimetric results by a third law calculation with the data of this investigation proving to be the most consistent. A solid state galvanic cell is employed to measure gallium activities in Ga–Sb liquid alloys. A survey of the available literature indicates gallium activities ranging from moderate positive to strong negative deviations from Raoult's law. Results show moderate negative deviations from ideality in the composition range 0,039 less than x/sub Ga/ less than 0,833. Partial molar enthalpies and entropies are calculated, and agree with calorimetric data. Results are combined with calorimetric data to calculate the liquidus temperatures of the Ga–Sb system, which are in excellent agreement with measurements. Effect of short-range ordering is also investigated. Coulometric titration techniques are used to investigate the solubility and diffusivity of oxygen in liquid indium. Dissolved atomic oxygen is found to follow Henry's law and a saturation solubility of x_o/sup sat/ equals 3.3×10^{-3} is determined at 908°K. From a galvanostatic response of an indium electrode, an oxygen diffusivity of 2.2×10^{-6} cm^2 s^{-1} is found, in good agreement with other available data. The application of CaF_2 as a solid electrolyte for solid state electrochemical studies is investigated. A theoretical basis is given for the use of fluorine-conducting CaF_2 with respect to Group III-V alloys. Experimental techniques are explored for the use of CaF_2 in an open cell arrangement. Experimental difficulties are found with several cell configurations though the emf response is in the correct direction and has the right order of magnitude. (auth)

20744 (NASA-CR-72294) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Semiannual progress report, 15 November 1966–14 May 1967. Luoma, W. L.; Walek, W. J. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 20 Jun 1967. 58p. (PWA-3129). Dep. NTIS $4.50.

The long-term total hemispherical emittance testing of two AISI-310 stainless steel tubes coated with calcium titanate and iron titanate was completed. Both specimens were tested at 1350°F in a vacuum of 1×10^{-7} mm Hg for 20,000 hours. The calcium-titanate-coated specimen demonstrated an emittance which

decreased gradually from 0.91 to 0.88 during the test. The coating remained extremely well bonded to the substrate with no significant changes occurring to the coating. The tested substrate was found to contain considerable quantities of both sigma and carbide phases. The substrate was slightly harder after testing than before, presumably as a result of the precipitation of sigma and carbide phases. No significant interdiffusion of the coating and substrate constituents occurred. The emittance of the iron-titanate-coated specimen remained essentially constant, with a small decrease from 0.89 to 0.87 during the test. The coating separated from the substrate at the ends of the specimen and around the black-body holes, but the area affected in the test section was small, and no significant change in the emittance was observed. Testing also resulted in some changes in the coating structure. A 5,000-hour cycling test of an iron titanate-coated niobium-1 percent zirconium tube was completed. The specimen was cycled between 1500 and 1800°F a total of 3125 times in a vacuum of 1×10^{-7} mm Hg. The time to complete one cycle was 96 minutes. The coating demonstrated a stable emittance of about 0.88 and had a good adherence to the substrate for the duration of the test. A 1500 to 1900°F cycling test of an iron titanate-coated niobium-1 percent zirconium tube was continued. The specimen has completed 5,000 hours of testing which includes 3115 cycles. The emmittance remained stable at about 0.89. Cracking occurred at the ends of the tube after about 3500 hours, but no spalling or separation of the coating was observed. The test will be continued to 10,000 hours. (auth)

20745 (NASA-CR-134526) INTERDIFFUSION BEHAVIOR OF TUNGSTEN OR RHENIUM AND GROUP V AND VI ELEMENTS AND ALLOYS OF THE PERIODIC TABLE. II. Appendices. Arcella, F. G. (National Aeronautics and Space Administration, Washington, D. C. (USA)). Sep 1974. 408p. (WANL-M-FR-74-005).

Dissimilar metal joints in thermionic power conversion systems can degrade through material interdiffusion. Such degradation effects occur as cracks in brittle intermetallic phases, as Kirkendall voids, or as an impurity which reduces the emittance efficiency of the diode. To resolve the time dependency of these effects, an experimental study was performed in which four diode emitter materials, arc cast W, CVD W, powder metallurgy Re, and CVD Re were hot press welded to Nb, Nb-1Zr, Ta, Ta-10W, T-111, ASTAR811C, Mo-50Re, W-30, 9Re-20, 1Mo, W-25Re, W or Re. The resulting bimetallic couples were vacuum aged for 100 to 2000 h at 1200-2000°C. Metallography and electron microprobe trace and spot count scans were used to analyze the extent of interdiffusion as a function of age time and temp. High-temp. solid-state interdiffusion between two metallurgically joined metals of widely different melting points was found to result in a coalescence of vacancies in the lower melting point material. Welded (hot isostatic pressure) interfaces with Re are not recommended for long-term elevated temperature service due to brittle intermetallic phases and cracks which form in the diffusion interface. (Metals Abstr.)

20746 (NSPM-2) THERMODYNAMIC PROPERTIES OF POTASSIUM. Kardys, C. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 15 Dec 1958. 23p. Dep. NTIS $3.50.

Potassium temperature-entropy and entropy-enthalpy charts for the temperature range between 1000 and 2000°F are presented. (auth)

20747 (NSPM-4) THERMODYNAMIC PROPERTIES OF CESIUM. Skaritka, J. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 18 May 1959. 15p. Dep. NTIS $3.50.

Charts of pressure-specific volume-temperature (PVT) and temperature-enthalpy for cesium in the 500 to 1300°F range are presented. (auth)

20748 (ORNL-SUB-3654-3) VARIABILITY IN CREEP AND RUPTURE TEST RESULTS IN A SINGLE HEAT OF TYPE 304 STAINLESS STEEL. R and D Report LR:75:4213-01:3. Leyda, W. E.; Schultz, C. C. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research Center). Sep 1975. 158p. Dep. NTIS $6.75.

For Oak Ridge National Lab., TN.

Results of uniaxial creep and rupture tests, from a single heat of type 304 stainless steel, are examined to determine the reasons for their greater-than-expected variability. The test results were obtained as part of a program to develop and verify high temperature structural design methods for liquid metal fast breeder reactor system components. A single heat of material (heat 9T2796) is being used throughout the program, by all investigators and in several product forms, to minimize the problem of heat-to-heat variations in elevated temperature behavior. The same laboratory reanneal was specified for each product form to reduce differences in behavior among the several being used. The data discussed was obtained from the 5/8-inch diameter, hot-rolled bar product form. The laboratory reanneal was performed after finish machining to minimize specimen-to-specimen differences. In spite of these efforts to reduce data variability, significant scatter was observed in both short-time and long-time deformation response, and also in time-to-rupture results. (auth)

20749 (ORNL-TM-5074) FABRICATION AND MECHANICAL TEST DATA FOR THE FOUR 6-INCH-THICK INTERMEDIATE TEST VESSELS MADE FROM STEEL PLATE FOR THE HEAVY SECTION STEEL PROGRAM. Childress, C. E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

The HSST Program has among its goals the objective of demonstrating the capability to predict safe behavior of thick-walled pressure vessels containing flaws of known dimensions under frangible, transitional, and tough loading regimes. To accomplish these objectives the program is conducting a series of tests involving 6-in.-thick pressure vessels which will serve as test specimens for assisting in the characterization of failure under these loading conditions. Among the vessels a number of parameters, such as weld type, weld location, flaw size and shape, and test temperature and pressure, will be selectively varied to show that a rationale exists for dealing with the varied stress and metallurgical states which normally exist in commercial nuclear reactor vessels. Each vessel will serve as a go, no-go determination of critical flaw size for a specific set of test parameters. Item 4 of the previous issues in this series covers the fabrication details of the first six 6-in.-thick test vessels, which were fabricated from ASTM A-508 Cl 2 forging materials. This report covers the fabrication details of four additional 6-in.-thick intermediate test vessels having shell courses fabricated from ASTM A-533 Gr B Cl 1 plate. The remaining components were made from forgings. Essentially this report is a continuation of ORNL-TM-4351; it describes the manufacturing details of the individual parts and their ultimate assembly into finished vessels. Details concerning chemical composition and mechanical and nondestructive test data are presented. (auth)

20750 (PWA-2206(Vol. 2)) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Progress Report, July 1, 1959-December 31, 1962. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). [nd]. 186p. Dep. NTIS $7.50.

Tables containing values of emissivity of refractory metals, alloys, and materials are presented. (JRD)

20751 (PWA-2206(Vol.3)) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Volume III. Interim Final Report, July 1, 1959-December 31, 1962. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 1962. Contract NASw-104. 177p. Dep. NTIS $7.50.

Data on emissivity of metals, alloys, and refractories are presented graphically. Diagrams and photographs of measuring equipment for emissivity investigations are also included along with photographs of various test specimens. (JRD)

20752 (PWAC-158) DEVELOPMENT OF SOLID-PHASE BONDING OF NICKEL BASE ALLOYS. Final Report, January 1-July 31, 1956. Werner, A. C.; Scheible, H. G.; Vartanian, H. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 1956. Contract AT(11-1)-229. 27p. Dep. NTIS $4.00.

An induction heated furnace was constructed for hot pressing Inconel-NiO sandwich specimens in a reducing hydrogen atmosphere. A study was made of the effect of several process variables on the ultimate shear strength of bonded double lap joints. Variables studied were sintering temperature, sintering pressure, sintering time, annealing time, bond thickness, reduction time, particle size of nickel oxide, surfact treatment, and the number of bond surfaces coated. Of these, the most important were determined to be sintering temperature, pressure, and time. Bonded joints which ranged in strength from 3,000 ψ to 40,000 ψ were obtained by control of these three variables. Sintering temperature was found to be more important than sintering pressure in the formation of strong bonds. A sintering pressure of at least 1.25 tsi, however, was necessary for the formation of bonds having strengths between 10,000 and 30,000 ψ. Annealing time, bond thickness, reduction time, particle size of nickel oxide, surface treatment, and the number of bond surfaces coated were less important for forming strong bonds. (auth)

20753 PHASE DIAGRAM OF THE ALUMINUM CORNER OF THE ALUMINUM-COPPER-CADMIUM ALLOY SYSTEM. Hisafuji, W.; Okamoto, T.; Kono, N. Keikinzoku; 24: No. 6, 246-253 (Jun 1974). (In Japanese)

The phase diagram in the Al corner of the Al-Cu-Cd system was studied by means of electrical-resistivity, lattice-spacing, and thermal analysis measurements together with microscopy observations. Isothermal cross-sections at 520°C showed that

the addition of Cd had little effect on the solubility of Cu in the Al–Cu–Cd alloy. (Metals Abstr.)

20754 STRUCTURE AND PROPERTIES OF ALLOYS OF TUNGSTEN WITH NIOBIUM, TANTALUM, RHENIUM, AND CARBON. Savitskii, E. M.; Povarova, K. B.; Makarov, P. V. pp 174-181 of Splavy Redk. Met. S Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

The effects of alloying of W with Nb, Ta, Re, and C on the structure, deformability, recrystallization temperature, and hardness at room and higher temperature were studied. Alloys are described which retain high hardness values of 200 to 250 kg/mm^2 up to 1000°C with the onset of recrystallization at 1550 to 1900°C, and which remain fine-grained after a recrystallization anneal at 1700 to 1900°C. (Metals Abstr.)

20755 UNIFORMITY OF PROPERTIES ACROSS THE SECTION OF A SUPERCONDUCTING WIRE. Goncharov, I. N. pp 78-82 of Splavy Redk. Met. S Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

X-ray microprobe analysis, electron microscopy, and other methods were used to study the microhardness, thermo-e.m.f. and composition variation across the section of a superconducting Nb–75% Zr wire of 0.29 mm dia. The results were compared with measurements of the superconducting properties of the center and peripheral regions of the same wire and indicate that, after heat treatment, precipitates exist in different quantities at various distances from the wire surface. (Metals Abstr.)

20756 EFFECTS OF [ADDITIONS INCLUDING] RARE METALS ON THE ACOUSTIC PROPERTIES OF MAGNESIUM. Drits, M. E.; Rokhlin, L. L. pp 109-113 of Splavy Redk. Met. S Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

Data are given for the effects of Ce, Nd, Zn, Cd, Ba, Al, and Sn on the attenuation of vibrations in Mg. The relation of this attenuation to the structure condition is discussed. (Metals Abstr.)

20757 FEATURES OF THE ELECTRICAL RESISTANCE OF TITANIUM, ZIRCONIUM, AND HAFNIUM. Bykov, V. N.; Rudnev, I. I.; Solov'ev, V. A. pp 156-158 of Splavy Redk. Met. S Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

Measurements are reported for the electrical resistance, ρ, of Ti, Zr, and Hf between 0 and 1200°C. Calculations of the temperature coefficients of ρ using a two-zone model suggest that both positive and negative carriers are involved in the conductivity. (Metals Abstr.)

20758 MECHANICAL PROPERTIES OF MOLYBDENUM–RHENIUM–CARBON ALLOYS. Savitskii, E. M.; Tylkina, M. A.; Fridman, Z. G.; Ermishkin, V. A.; Konieva, L. Z. pp 161-163 of Splavy Redk. Met. S Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

Studies were made of the mechanical properties of Mo–Re–C alloys in the deformed and annealed conditions at room and elevated temperature. The alloys studied were: (i) MR47VP and (ii) Mo–45% Re–0.12% C. Alloys (ii) had the higher strength properties in the range 600 to 1000°C and was only slightly inferior to (i) in ductility in this range; no significant difference in properties existed above 1200°C. The ductility of (i) was greater than that of (ii) above 800°C. At 1100°C, the creep resistance of (ii) was better by ~5 kg/mm^2 than that of (i) over the whole range of creep rates studied. (Metals Abstr.)

20759 CRACK ARREST IN STEELS. Hahn, G. T.; Hoagland, R. G.; Kanninen, M. F.; Rosenfield, A. R. (Battelle Columbus Labs., OH). Eng. Fract. Mech.; 7: No. 3, 583-591(Sep 1975).

Theories that have been used to characterize the crack arrest capabilities of steels and structures are examined including the static analysis, arrest toughness (K_{Ia}) theory; the dynamically loaded/stationary crack toughness (K_{Id}) theory; and the dynamic analysis, propagating crack energy or toughness (R_{ID} or K_{ID}) theory. These three concepts are examined in the light of measurements of unstable fracture and crack arrest in wedge-loaded DCB test pieces together with a fully dynamic analysis of the experiments. (auth)

20760 SOME CHARACTERISTICS OF THE ELECTRICAL DISCHARGE MACHINING OF NARROW GAPS. Stavitskii, B. I. Elektron. Obrab. Mater.; 1: 10-12(1975). (In Russian)

The effect of the mode and conditions of electrical discharge machining on the rate of material removal during the creation of narrow gaps and grooves by means of hard-alloy tool electrodes is discussed. The tools under consideration are 0.06 × 0.6 mm^2 in size and consist of alloys of the WC–Co and WC–TiC–Co systems; they are used for machining Cr–Ni steels. If the pulse energy supplied by the condensers shunting the electrodes is kept constant, then on reducing the length of the discharge circuit by an order of magnitude the time required to create gaps of specified size diminishes by a factor of three, the wear on the tool electrode being unaltered. (Metals Abstr.)

20761 INCREASING THE LIFE OF PARTS BY REPEATED ELECTRIC-SPARK ALLOYING. Andreev, V. I.; Derevyanko, V. I.; Beda, N. I.; Ginzburg, B. I.; Kostenko, N. P. Elektron. Obrab. Mater.; 1: 84-85(1975). (In Russian)

The results of laboratory and semi-industrial tests on the use of repeated electric-spark alloying for increasing the service life of heavily-stressed parts such as the working surfaces of dies and press tools are presented and analyzed. The dies are originally made from C steel U8A heat-treated to a hardness of HRC 58 to 65. The alloying material is a hard alloy of the WC to Co type. After 10 to 12 days normal working or 6–7 × 10^4 cycles, whichever period is completed first, the dies are subjected to a second alloying, and so on. In this way the service life may be increased by a factor of 5 to 6 times. (Metals Abstr.)

20762 ULTRASONIC ATTENUATION IN NORMAL METALS. Rayne, J. A. (Carnegie–Mellon Univ., Pittsburgh). pp 13-51 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844–P1.

This paper reviews recent experimental and theoretical work on the electronic contribution to the attenuation of sound in normal metals. Particular attention is paid to the behavior of shear waves, including electromagnetic breakdown effects and anomalies in the temperature dependence of the shear wave attenuation in niobium and rhenium. New magnetoacoustic data on cesium and copper are discussed, as well as Doppler-shifted acoustic cyclotron resonance experiments on aluminum and indium. An extensive bibliography of recent acoustic attenuation experiments at low temperatures is provided. (13 figs) (auth)

20763 EFFECTS OF FERMI SURFACE ANISOTROPY ON THE ATTENUATION OF SHEAR WAVES IN CADMIUM AND ZINC. Almond, D. P.; Lea, M. J.; Dobbs, E. R. (Univ. of Lancaster, Eng.). pp 94-97 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844–P1.

A study was made of the electronic attenuation of ultrasonic shear waves in pure Cd and Zn at low temperatures. Relations of the Fermi surfaces to these measurements are discussed. Results can be explained by Fermi spheres. (DLC)

20764 ULTRASONIC ATTENUATION IN n-GaP AND p-InSb AT LOW TEMPERATURES. Boyle, W. F.; Sladek, R. J. (Purdue Univ., West Lafayette, IN). pp 98-106 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844–P1.

Measurements of the attenuation, α, of 30MHz bulk ultrasonic waves were made in single crystal samples of undoped and sulfur-doped n-GaP and of copper-doped p-InSb between 4.2 and 240°K. Centered around some low T is a narrow maximum in α for piezoelectrically active waves. The maxima are due to the decreased screening of piezoelectric fields as charge carriers drop from band to impurity states with decreasing T. Although the experimental peaks cannot be accounted for quantitatively by means of theory using measured resistivity values, they can be fitted exactly by letting the electromechanical coupling factor and the electrical resistivity take suitable values. This implies that the samples are somewhat inhomogeneous in resistivity. It is found that $|e_{14}| = 0.058 \pm 0.006$ C/m^2 for InSb and 0.084 ± 0.003 C/m^2 for GaP, where e_{14} is the piezoelectric constant. No accurate value of $|e_{14}|$ for GaP has been published previously. The transfer of bond charge implied by the values of e_{14} for these and other zinc blende compounds is found to have a dependence on ionicity like that implied by recent theory. (auth)

20765 ULTRASONIC ATTENUATION IN THIN POLYCRYSTALLINE TIN FILMS. Free, J. U. Jr.; Strandberg, M. W. P. (Massachusetts Inst. of Tech., Cambridge). pp 107-118 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844–P1.

This paper is a preliminary report on the study of longitudinal ultrasonic waves reflected from a thin metallic film at low tem-

perature. The experiments were performed on evaporated tin films between 2.8-μ and 6.3-μ thickness. The measurements were made in the frequency range 8.9 to 9.4 GHz. A variation of the pulse echo technique was used. The tin film was deposited on one end of a quartz rod, and the other end was excited by a conventional non-resonance piezoelectric method using an X-band re-entrant cavity. Amplitude measurements were made on the pulse echoes reflected from the tin film; the difference between the ultrasonic wave reflected from the film in the superconducting and normal state was measured. (DLC)

20766 ELECTRONIC ATTENUATION OF ULTRASOUND IN THE INTERMEDIATE STATE OF ALUMINIUM AND ZINC. Lea, M. J.; Lyall, K. R.; Meredith, D. J.; Read, E. (Univ. of Lancaster, Eng.). pp 119-122 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

In several experiments in the parallel field geometry, we have found the equation $\alpha_i = n\alpha_n + (1-n)\alpha_s$ to be valid rather than the equation $\exp(-\alpha_i) = n\exp(-\alpha_n) + (1-n)\exp(-\alpha_s)$ and two reasons are suggested. Firstly, when the electron mean free path exceeds the laminae thickness, the attenuation mechanism becomes non-local in nature. Secondly, with thick samples, a slight misorientation of the phase boundaries and the sound wavevector means that each part of the sound beam samples the same fraction of normal material. (auth)

20767 ULTRASONIC ABSORPTION IN KONDO SUPERCONDUCTORS. Hilton, P. A.; Meredith, D. J. (Univ. of Lancaster, Eng.). pp 123-126 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

Measurements were made on Zn containing 6.5 and 10 ppM Mn. The initial decrease of T_c with Mn content was 400°K/at.%. The probable range of gapless superconductivity is indicated on the basis of the Abrikosov and Gor'kov theory. The temperature variation of the attenuation is shown for the 6.5 ppM Mn alloy.

20768 MECHANISM OF ATTENUATION SOUND OSCILLATIONS IN FILMS AT SUPERCONDUCTION TRANSITION. Postnikov, V. S.; Zolotukhin, I. V.; Miloshenko, V. E.; Shunin, G. E. (Polytechnical Inst., Voronezh, USSR). pp 137-150 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

A narrow internal friction peak was discovered in the region of the n - s transition of V and Ta, and an attempt is made to explain it. It is noted that a small peak $Q^{-1}(H)$ in small magnetic region is apparently associated with dissipation processes which are due to nonequilibrium in conduction electron system of a superconductor. This nonequilibrium occurs in electron system at formation of mixed (intermediate) state in a superconductor. (DLC)

20769 EFFECT OF ULTRA HIGH VACUUM DEGASSING ON THE INTERNAL FRICTION OF TANTALUM AND NIOBIUM. Mazzolai, F. M. (CNR, Rome). pp 214-221 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

Internal friction measurements were made in Nb and Ta after annealing in μhv, hydrogen loading, and cold working. Relaxation peaks appear in both metals at $\sim 0.05T_m$, have similar relaxation parameters, need high temperature anneals for their appearance, and are not very sensitive to hydrogen loading. It is suggested that a dislocation array may be responsible for the anelasticity. (DLC)

20770 INTERNAL FRICTION ASSOCIATED WITH SUBSTITUTIONAL-INTERSTITIAL SOLUTE-ATOM CLUSTERS IN IRON-VANADIUM-NITROGEN ALLOYS AND OTHER TERNARY NITROGEN-FERRITES. Pope, M.; Jones, D. M.; Jack, K. H. (Univ. of Newcastle on Tyne, Eng.). pp 266-275 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

When iron containing strong nitride formers such as V, Ti, Mo, and Cr is nitrided under suitable conditions, mixed substitutional-interstitial solute-atom clusters are produced as discs on the ferrite cube planes. Although the internal friction Snoek peak is then extremely small, and interaction peaks (due to stress-induced diffusion of N between interstices in the vicinity of substitutional atoms) are absent, relatively strong damping is observed at 150-220°C. The peak temperature depends upon the nitriding treatment and it is suggested that the effects arise from the movement of the less firmly held N atoms at the edges of the clusters. (auth)

20771 INTERNAL FRICTION DIE TO OXYGEN IN ULTRA PURE ZIRCONIUM. Gacougnolle, J. L.; Sarrazin, S.; de Fouquet, J. (CNRS, Poitiers, France). pp 343-351 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

Results show that oxygen produces a relaxation peak only for sufficiently high oxygen contents. The smallness of the peak seems related to the partially ionic bond and to the complex clusters. (DLC)

20772 RELATION BETWEEN INTERNAL FRICTION SPECTRA AND THE ATHERMAL β IN EQUILIBRIUM ω TRANSFORMATION IN Ti-V, Ti-V-O AND Ti-V-H ALLOYS. Buck, O.; Thompson, D. O.; Paton, N. E.; Williams, J. C. (Rockwell International, Thousand Oaks, CA). pp 451-458 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

Unexpectedly large effects of oxygen and hydrogen on the low temperature internal friction peaks associated with athermal $\beta \rightleftarrows \omega$ transformation in Ti-V alloys were observed using combined damping and modulus measurements and cold stage electron microscopy. The measurements show that O suppresses the ω start temperature, whereas H raises it. It is speculated that not only the size of the dopants but also their electronic state contribute to changes occurring in metastable β alloys.

20773 PHONON DISLOCATION DRAG AND THE FORM OF THE PHONON SPECTRUM. Martin, J. W.; Paetsch, R. (Technical Univ. of Denmark, Lyngby). pp 197-200 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

Models other than the Debye model are used for the phonon spectrum and their effect on the form of the phonon dislocation drag constant B_{ph} was studied. Values of B_{ph} were calculated for a series of metals using the Debye model. B_{ph} in metals is found to be sensitive to the form of the Grueneisen parameter and the phonon frequency but not to the relaxation time, but in alkali metal halides are sensitive to all three. (DLC)

20774 INTERNAL FRICTION PEAKS OBSERVED IN W SINGLE CRYSTALS AFTER SMALL DEFORMATION. Rieu, G. E. (Univ., Poitiers, France). pp 343-351 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

Two series of peaks were observed after annealing and deformation and correspond to different structures. Interpretations are offered for the peaks. It is concluded that the high-purity W monocrystals are sensitive to any small deformation and that the orientation affects the internal friction spectra when it is favorable to the creation of internal residual stresses. (DLC)

20775 ANELASTIC EFFECTS DUE TO DISLOCATIONS IN LOW TEMPERATURE COLD-WORKED TITANIUM AND ZIRCONIUM. Petit, J.; Quintard, M.; Mazot, P.; de Fouquet, J. (CNRS, Guillaume, France). pp 407-414 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

Internal friction spectra were measured in Ti and Zr prestrained by tension at 77°K or at room temperature. It is shown that the relaxation spectra in Zr but not in Ti are very dependent on the deformation temperature. Mechanisms for the P_1 and P_2 peaks are discussed. (DLC)

20776 NICKEL-BASE ALLOYS HAVING A LOW COEFFICIENT OF THERMAL EXPANSION. Baldwin, J. F.; Maxwell, D. H. (to Sorcery Metals, Inc.). US Patent 3,918,964. 11 Nov 1975. Filed Date 21 Dec 1973. 12p.

Alloy compositions consisting predominantly of nickel, chromium, molybdenum, carbon, and boron are disclosed. The alloys possess a duplex structure consisting of a nickel–chromium–molybdenum matrix and a semi-continuous network of refractory carbides and borides. A combination of desirable properties is provided by these alloys, including elevated temperature strength, resistance to oxidation and hot corrosion, and a very low coefficient of thermal expansion. (auth)

20777 RELATIVE WORK FUNCTION OF CLEAN MOLYBDENUM SINGLE-CRYSTAL PLANES DETERMINED BY FIELD EMISSION MICROSCOPY. Bergeret, G.; Abon, M.; Tardy, B.; Teichner, S. J. (CNRS, Villeubanne, France). J. Vac. Sci. Technol.; 11: No. 6, 1193-1194(1974).

A probe-hole field emission microscope was used to determine the work function of clean molybdenum single crystal planes relative to the average work function of the field emitter, assumed to be 4.20 eV. Results are compared with other available data. (AIP)

20778 NIOBIUM ALLOYS FOR STRUCTURAL APPLICATIONS. Tavassoli, A. A. SAMPE J.; 11: No. 1, 14-19(1975).

In view of the growing aerospace need for high-temperature materials, four sheet Nb alloys have been evaluated. Tensile tests have been carried out on Nb752, FS85, SU31 and WC3014 from room temperature to 1427°C in a vacuum $1.33-7.99 \times 10^{-3}$ N/m^2. Bend transition temperature of the alloys in uncoated, coated, and welded conditions also have been reported. From the over-all strength and ductility standpoint, it is found that FS85 is superior for structural applications, where creep rate is the principal material selection criterion, but Nb752 being slightly superior to FS85 from tensile strength standpoint. The higher elevated temperature strength of SU31 is marred by its relatively high ductile-to-brittle transition temperature in welded conditions. WC3015 has been found to be unsuitable for sheet structure application. (Metals Abstr.)

20779 OXYGEN DISTRIBUTION IN SPUTTERED Nb-Ge FILMS. Gavaler, J.R. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235); Miller, J.W.; Appleton, B.R. Appl. Phys. Lett. 28: No. 4, 237-239 (15 Feb 1976).

A quantiative determination of the distribution of oxygen in a high-T_c (22 K) Nb-Ge film has been made using a nuclear backscattering method. The Nb/Ge ratios as a function of depth have also been determined. An apparent correlation between oxygen concentration and Nb/Ge ratio is observed. (auth)

20780 THERMAL PROPERTIES OF Nb FROM ACOUSTIC AND ELECTRICAL RESISTIVITY MEASUREMENTS IN THE TEMPERATURE RANGE 60–340 K. Cannelli, G.; Cannelli, G.B. (C. N. R.-Istituto di Acustica "O. M. Corbino", Roma, Italy). J. Appl. Phys. 47: No. 1, 17-21 (Jan 1976).

The thermal diffusivity and the relative difference in molar heat capacities, $(C_p - C_v)/C_v$, of polycrystalline niobium have been derived from acoustic measurements in the temperature range 60–340 K. The electrical resistivity has also been measured from 8 to 340 K; 0.833 μΩ cm, 18.7, and 9.25 K being the values of residual resistivity ρ_0, resistance ratio ρ (300 K)/ρ_0, and superconducting transition temperature, respectively. The thermal conductivity, Lorenz ratio, and molar heat capacity at constant volume have been calculated for the temperature range 60–340 K, using present values of thermal diffusivity, electrical resistivity, and literature values of specific heat C_p. A shallow maximum in the derived thermal conductivity curve is observed around 180 K where the Lorenz ratio assumes the maximum value 3.15×10^{-8} W Ω K^{-2}. It is suggested that the thermal conductivity maximum may originate in the phonon contribution. (auth)

20781 QUASISTATIC DEFORMATION OF POROUS BERYLLIUM AND ALUMINUM. Schock, R.N.; Abey, A.E.; Duba, A. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). J. Appl. Phys. 47: No. 1, 53-63 (Jan 1976).

Loading and unloading of two types of porous beryllium and a porous aluminum under conditions of uniaxial strain, proportional loading, and hydrostatic pressure indicate that yielding is dominated by porosity. Analysis of the data prior to yielding indicates that aspherical pores cause increased compressibility on initial loading. All materials exhibit enhanced compaction when loaded under nonhydrostatic stress conditions. Models which treat the collapse of spherical pores do not agree with the beryllium data, probably because of the influence of aspherical pores and pore-size distribution. (auth)

20782 OBTAINING DENSITIES OF STATES FROM TUNNELING BETWEEN TWO SUPERCONDUCTORS. Vopat, F.E.; Lee, H.J.; Tomasch, W.J. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). J. Appl. Phys. 47: No. 1, 329-332 (Jan 1976).

We consider tunneling between two superconductors, S_A and S_B, in the approximation that S_A is a BCS superconductor and that thermal excitations are unimportant. Inversion formulas are developed which permit numerical evaluation of the tunneling density of states for S_B when the ac conductance, or its voltage derivative, is known as a function of bias voltage. The method is applied to finely spaced (~30 μV) conductance structure produced by quasiparticle interference phenomena in a thick (~30 μm) In film at 0.3 K (so-called Tomasch effect). (auth)

20783 PREPARATION AND SOME MAGNETIC PROPERTIES OF AMORPHOUS Gd_xFe_{1-x} ALLOY THIN FILMS. Mimura, Y.; Imamura, N.; Kobayashi, T. (KDD Research and Development Laboratory, Nakameguro, Tokyo 53, Japan). J. Appl. Phys. 47: No. 1, 368-370 (Jan 1976).

Amorphous Gd_xFe_{1-x} ($0 \leqslant \chi \leqslant 0.35$) thin films were prepared by rf cosputtering using the iron target covered partially with small gadolinium pieces. The composition dependences of the saturation magnetization, *M-H* loops, and domain structures were studied. The coercive force was obtained as a function of the composition and temperature. Such magnetic properties of GdFe sputtered films were very similar those of amorphous GdCo films. (auth)

20784 DIPOLE ENERGY DISSIPATION AND NUCLEAR SPIN DIFFUSION IN MIXED-STATE SUPERCONDUCTING VANADIUM. Genack, A.Z. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Phys. Rev. B 13: No. 1, 68-80 (1 Jan 1976).

The decay of nuclear spin-spin energy has been studied in the mixed state of vanadium and anomalously rapid relaxation rates are found as compared to the rates for spin-lattice relaxation of Zeeman energy. The experiment was performed by adiabatically demagnetizing the spins in the rotating frame at a field larger than H_{c2} and then cycling the field to bring the sample into the mixed state for a variable time. The residual dipolar energy is detected, once the field is raised, by adiabatically remagnetizing the sample on resonance. I show that the relaxation observed, after the vortices are pinned, is due to a cross relaxation of a spin energy associated with the magnetic field gradients in the mixed state and the dipolar energy which is in semiequilibrium with the quadrupole energy. This process is mediated by a current of magnetization, proportional to the diffusion coefficient D, which is driven by the field gradients and uses dipolar energy as a heat sink. Using a field distribution in the mixed state calculated by Marcus, I find $D = 2.8 \pm 0.9 \times 10^{-12}$ cm^2 sec^{-1} from the measurements of the relaxation rate of dipolar energy and of the quadrupole system heat capacity. This measurement of D is the first for a metal or for nuclei with $I > 1/2$ and is twice the value predicted by the moment-moment calculation of Redfield and Yu. In the presence of large field gradients, dynamic quenching of the diffusion is observed. (auth)

20785 CRITICAL MAGNETIC FIELD OF SUPERCONDUCTING THALLIUM. Alterovitz, S. (Physics Department and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 13: No. 1, 121-125 (1 Jan 1976).

The critical magnetic field of superconducting thallium has been measured in the range 0.3–2.38 K. The temperature scale was defined by the critical magnetic field of indium. The measured value of the usual superconductive parameters are $T_c = 2.382 \pm 0.001$ K, $H_0 = 177.20 \pm 0.05$ G, $\gamma^* = 890 \pm 6$ erg/cm^3 K^2 and $dH_c/dT|_{T_c} = 136.5 \pm 0.7$ G/K. The values of H_0 and $dH_c/dT|_{T_c}$ are in contradiction with existing magnetic field measurements. The values $\langle a^2 \rangle = 0.01 \pm 0.01$ and $2\epsilon_0/kT_c = 3.71 \pm 0.13$ were estimated for the anisotropy parameter and the average energy gap, respectively. (auth)

20786 PARAMAGNETIC ANISOTROPY OF DYSPROSIUM- AND HOLMIUM-YTTRIUM ALLOYS. Boutron, P.; Aléonard, R. (Laboratoire de Magnétisme, Centre National de la Recherche Scientifique B.P. 166, 38042-Grenoble-Cedex, France). Phys. Rev. B 13: No. 1, 174-179 (1 Jan 1976).

The paramagnetic susceptibility of Y–2-at.%-Dy, Y–25-at.%-Dy, Y–50-at.%-Dy, and Y–2-at.%-Ho solid-solution single crystals have been measured between 100 and 360 K. In the alloys with Dy, the anisotropy of the reciprocal susceptibility increases only very slowly with the concentration. This may mean that bilinear exchange anisotropy is small. The thermal variation of the second-order one-ion anisotropy parameter $\alpha^0_{2\gamma}$ is in agreement with the screened point-charge model. When evaluated at sufficiently high temperature, the variation of $\alpha^0_{2\gamma}$ from one rare earth to another is found to be close to that corresponding to this model. (auth)

20787 IMPROVEMENTS IN Nb_3Sn BY Al ADDITIONS TO THE BRONZE MATRIX. Dew-Hughes, D.; Luhman, T. S.; Suenaga, M. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc., 22: 158-159(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20788 PREDICTING THE STRAIN TO TERTIARY CREEP FOR ELEVATED-TEMPERATURE STRUCTURAL MATERIALS. Booker, M. K.; Sikka, V. K. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 196(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20789 EFFECT OF THE SUPERCONDUCTING TRANSITION ON THE INTERNAL FRICTION AND ELASTIC MODULUS OF NIOBIUM–TITANIUM ALLOYS. Savitskii, E. M. pp 31-35 of Splavy Redk. Met. s Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

Studies were made of the effect of the superconducting transition temperature, T_c, on the internal friction and elastic modulus, E, of Nb and Nb–Ti alloys containing Ti 25, 50, 75, or 80 at.-%. The maximum in internal friction at T_c is caused by the presence of normal and superconducting phases. With strongly deformed specimens the internal-friction background is much lower in the superconducting state than in the normal state, this effect being associated with a reduced inhibiting action of electrons on dislocations in the former state. At T_c a discontinuity in E occurs and its size is largely determined by the dislocation structure. (Metals Abstr.)

20790 REACTIONS OF THE (111) SURFACE OF Ta WITH O_2, CO AND CH_4 OBSERVED WITH LEED, WITH SPECIAL REGARD TO FACETTING. Bakker, L.; Okkerse, B. (Delft Univ. of Tech., Netherlands). Delft Prog. Rep., Ser. A; 1: No. 4, 97-102(Oct 1975).

The interaction of Ta (111) with oxygen provides a series of patterns, all with a threefold superstructure, but without distinct facetting. Facetting, however, is observed when carbon is present together with oxygen. It depends on the concentrations of these two elements whether {334} or {112} facet planes will develop. Changes in work function occurring during adsorption of O_2 and CO and also after ion bombardment have been measured, making use of the "grazing emergence condition" of a diffracted beam. The results favor the assumption that the absorbed molecules (atoms, ions), and also occluded argon, can be located below the top layer of atoms. Under equilibrium conditions, very low bulk concentrations of oxygen appear to correspond to surface structures which are relatively oxygen rich; the reverse appears to be the case for carbon. (auth)

20791 TARGET CHAMBER DESIGNED FOR ADSORPTION STUDIES USING CHARGED-PARTICLE-INDUCED NUCLEAR REACTIONS. Chartoire, M. Y. (Univ. Claude Bernard, Lyon); Engerran, J.; Thomas, J. P.; Tousset, J.; Bussiere, P. Thin Solid Films; 30: No. 2, 311-318(Dec 1975).

Charged-particle-induced nuclear reactions at low energy are particularly suitable for the surface determination of small amounts of light elements. The adsorption of carbon and oxygen can be followed in this way when the environment of the sample is not subject to external contamination. A target chamber with ultra-high and controlled vacuum has been designed for this purpose, the main feature being the use of thin metallic windows insulating the chamber from the beam line and the detection system. Due to the nature of the detected events (charged particles from (d, p) reactions) the distortion of the spectra obtained does not prevent quantitative determination of the two elements detected on the sample. Moreover these windows allow complete disconnection of the chamber from the beam line and the detector assembly during the necessary baking (outgassing of the walls). Preliminary results using a $CO/O_2/N_2$ gas mixture adsorbed onto a polycrystalline platinum sample are given, showing an excess of carbon. Limitations and improvements of the system and the method are discussed. (auth)

20792 METALLIC HYDROGEN. Caron, L. G. (Sherbrooke Univ., Quebec). Comments Solid State Phys.; 6: No. 5-6, 103-115(1975).

It is stated that metallic hydrogen is of interest theoretically since it is one of the few substances whose properties can be determined from first principles, but it offers great difficulty in experimental work because of the extremely high pressures required. It may be regarded as a proton lattice embedded in a sea of loosely bound electrons. An account is given of earlier and more recent work on this somewhat hypothetical phase. (21 references) (UK)

20793 STRUCTURE OF DISLOCATIONS IN TANTALUM AND TANTALUM-NITROGEN ALLOYS. Welsch, G.; Gibala, R.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). Acta Metall.; 23: No. 12, 1461-1468(Dec 1975).

Weak-beam electron microscopy of Ta and Ta–N crystals deformed at 77°K shows that the image widths of ½[111] screw dislocations are approximately 10 to 25 A, regardless of the nitrogen concentration between approximately 5 and 15,000 at. ppM. Annealing treatments designed to decorate screw dislocations with nitrogen atmospheres have no effect on the widths. Furthermore, no dissociations are observed at the nodes of the dislocation reactions ½[111] + ½[1 anti 11] equals [100]. It is concluded that the splitting of screw dislocation cores of approximately 50 A observed by field ion microscopy is enhanced by the local electric field; actual dissociations must be much smaller. Models of interstitial hardening in bcc metals which rely on interstitial-enhanced core expansion of screw dislocations are also not supported by the present results. (auth)

20794 CONSTRAINED DEFORMATION OF MOLYBDENUM SINGLE CRYSTALS. Carpay, F. M. A.; Chin, G. Y.; Mahajan, S.; Rubin, J. J. (Bell Labs., Murray Hill, NJ). Acta Metall.; 23: No. 12, 1473-1478(Dec 1975).

High-purity molybdenum single crystals were deformed at room temperature in both free compression and plane strain compression. In free comparison, crystals were oriented with [100], [110], and [111] parallel to the compression axis. The orientations for plane strain compression were (110)[001], (110)[110], (100)[011], and (100)[010], with (hkl) being the plane of compression and [uvw] the elongation direction. Change in width of the specimen is suppressed by a channel. The resulting stress-strain (sigma-epsilon) curves were converted to resolved shear stress: resolved shear strain (tau-gamma) curves using the Taylor–Bishop–Hill analysis. It was found that the tau-gamma curves do not form a narrow band if (110)[111] slip is assumed. A narrow band is formed, however, if asymmetric (112)[111] slip is assumed along with (110)[111] slip, with tau/sub 112H/ equals tau_{110} equals 1.3 tau/sub 112E/, where tau_{110}, tau/sub 112H/ and tau/sub 112E are the CRSS for (110) slip, (112) slip in the antitwinning sense, and (112) slip in the twinning sense respectively. Thus it may be concluded that the Schmid law is obeyed in high-purity Mo deformed at room temperature by assuming a combination of asymmetric (112)[111] and (110)[111] slip systems. (auth)

20795 DIFFUSION AND PHASE TRANSFORMATION IN ELEMENT epsilon-(Ag, Cd) ALLOY ELECTRODES AT 25, 50, AND 75°C. Schwitzgebel, G.; Michael, P.; Zohdi, Y. Acta Metall.; 23: No. 12, 1551-1554(Dec 1975).

The anodic behavior of polycrystalline epsilon-(Ag, Cd) subjected to low current densities can be quantitatively interpreted from chronoammeter experiments and x-ray analysis of the electrode surface. Voltage outputs from the reversible potential range of the epsilon-phase lead to diffusion polarization in the metal which, in the case of quenched specimens with small grain sizes, indicates the predominance of grain boundary diffusion. Superposed voltages in the range of the gamma'-phase entail an epsilon yields gamma'-phase change. In the solvent DMSO the nucleation of gamma' is retarded such that an epsilon-phase supersaturated with Ag results in the first time stage. A 2-phase diffusion law is successfully applied. Diffusion coefficients for volume and grain boundary diffusion in epsilon-(Ag, Cd) and the respective activation energies are given. (auth)

20796 HELIUM TRAPPING AND RETRAPPING IN VACANCIES: A DIFFUSION MODEL TO CALCULATE DESORPTION SPECTRA. Roodbergen, C.; Veen, A.; Caspers, L. M. (Delft Univ. of Tech., Netherlands). Delft Prog. Rep., Ser. A; 1: No. 4, 107-114(Oct 1975).

A program has been developed that simulates, in a desorption experiment, the diffusion and trapping into vacancies of injected helium, and the desorption of this helium from He/sub n/V complexes (n equals 1 to 4) during a heating cycle with linear temperature transient. Calculated results for the case of tungsten show that the desorbed helium may be retrapped before reaching the crystal surface. In high dose/high damage experiments this retrapping causes a substantial shift of desorption peak temperatures. (auth)

20797 FATIGUE-CRACK PROPAGATION BEHAVIOR OF INCOLOY 800 AT ELEVATED TEMPERATURES. James, L. A. (Westinghouse Hanford Co., Richland, WA). J. Eng. Mater. Technol.; 96: No. 4, 249-254(Oct 1974).

Linear-elastic fracture mechanics techniques were used to characterize the fatigue-crack propagation behavior of Incoloy 800 in an air environment over the temperature range 75 to 1200°F. Crack growth rates were measured over the range 5×10^{-7} to 5×10^{-5} in./cycle. Material Grades 1 and 2 were found to exhibit essentially the same behavior over this range. In general, crack growth rates increased with increasing test temperature, although the increases were less than previously noted for austenitic stainless steels. This difference is probably related to the superior oxidation resistance of Incoloy 800. (auth)

20798 CRACKING OF Ti–6Al–4V ALLOYS UNDER SUSTAINED LOAD IN AMBIENT AIR. Yoder, G. R.; Griffis, C. A.; Crooker, T. W. (Naval Research Lab., Washington, DC). J. Eng. Mater. Technol.; 96: No. 4, 268-274(Oct 1974).

Results of a study reveal that degradation in load-carrying capacity owing to sustained-load cracking (SLC) can occur in alloys of the Ti–6Al–4V family. Each of eight alloys tested with fatigue-precracked specimens in ambient room air exhibited the phenomenon, with degradations ranging from 11 to 35 percent. The degree of susceptibility to SLC was seen to be dependent upon crack orientation in rolled plate materials. The threshold stress-intensity factor below which SLC failures will not occur in these alloys, K/sub It/, appears to represent a more conservative fracture-safe design parameter than the plane-strain fracture toughness K/sub Ic/, which cannot account for time-delayed failures owing to SLC. (auth)

20799 INTERPRETATION OF THE YODER–GRIFFIS–CROOKER OBSERVATIONS OF SUSTAINED-LOAD CRACKING IN Ti–6Al–4V. Krafft, J. M. (Naval Research Lab., Washington, DC). J. Eng. Mater. Technol.; 96: No. 4, 275-282(Oct 1974).

Their recent NRL report documents a substantial degradation in load carrying capability of partially cracked specimens of annealed Ti–6Al–4V plate in a room air environment. The effect is analyzed as a special case of tensile ligament instability model, set up to permit integration of crack growth rate over the path to K/sub Ic/. Results show that the time dependence and magnitude of the load carrying capability and of the sustained load crack growth SLC are predictable from plastic flow characteristics, including the transient stress relaxation rate, and from a slight environmental effect. A simplified diagram for engineering assessment of SLC is presented. Importance is attached to the persistence of stress relaxation, as much as to its rate, in inducing SLC. Little effect is expected from the level of fracture toughness to the extent that it is controlled by the process zone size d/sub T/. (auth)

20800 DEVELOPMENT AND STUDY OF SAMARIUM–COBALT PERMANENT MAGNETS. Savitskii, E. M. pp 92-96 of Splavy Redk. Met. s Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

Methods and techniques for the preparation of pressed and sintered Sm–Co permanent magnets are described and data for mechanical and magnetic properties presented. The mean levels of magnetic energy and coercive force for these magnets can reach values of 9 to 11 MGs.Oe and 6 to 7 kOe, respectively. (Metals Abstr.)

20801 EFFECT OF COATING REGIMES ON THE STRUCTURE AND SUPERCONDUCTING PROPERTIES OF [NIOBIUM] STRIP COATED WITH Nb_3Sn. Savitskii, E. M. pp 85-88 of Splavy Redk. Met. s Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

The phase composition, thickness, density, uniformity, and superconducting properties of Nb strip coated with Nb_3Sn by hot-dip tinning were determined with respect to the coating process parameters, i.e., the temperature of the tinning bath, time of the Nb–Sn reaction, composition of the bath, and the method of heat treatment. The optimum bath temperature is 940 to 960°C. The Nb_3Sn thickness can be significantly increased with a corresponding increase in critical current by the use of a thermo-diffusion anneal. However, the nature of the Nb_3Sn layer can alter during the continuous process of its formation because of bath instability, and to produce high superconducting properties, a method for continuous checking and correction of the process is described. (Metals Abstr.)

20802 NUCLEAR DIPOLE RELAXATION AND SPIN DIFFUSION IN MIXED-STATE SUPERCONDUCTING VANADIUM. Genack, A. Z. New York; Columbia Univ. (1975). 134p. University Microfilms Order No. 75-27,414.

Thesis (Ph. D.).

Anomalously rapid relaxation of dipole-dipole energy was in mixed-state superconducting vanadium. This is explained by showing that spin diffusion driven by an inhomogeneous magnetic field uses spin-spin energy as a heat sink. Thus, a flow of magnetization in a nonuniform field is accompanied by a change of nuclear Zeeman energy which is compensated for by the nuclear dipole energy reservoir. Coupled differential equations are proposed for magnetization and spin-spin energy. It is concluded that spin diffusion cannot be a relaxation mechanism for magnetization in the mixed state, as previously assumed. To perform the experiment the sample was adiabatically demagnetized in a field larger than H/sub C_2/ and then the field lowered into the mixed state for a variable time. The field is then raised to resonance and the residual dipole energy is detected after adiabatic remagnetization in the rotating frame. From the relaxation rate a value of D equals 2.8×10^{-12} cm^2 is inferred for the diffusion coefficient. A decrease in D was observed when the field difference between neighboring spins becomes comparable to the local dipole field. (Diss. Abstr. Int., B)

20803 PRECISION VOLT–AMPERE MEASUREMENTS OF TUNGSTEN POINT FIELD EMISSION. Buder, E. E. St. Louis; St. Louis Univ. (1974). 227p. University Microfilms Order No. 75-26,228.

Thesis (Ph. D.).

Electric field electron emission from etched tungsten points was measured with maximum errors of +-0.05 percent in potential and +-2 percent in current. Precision pulse generation and differential oscillography removed usually observed charging current errors. Emitter surface cleanliness was achieved by 2000^0K flashing in 10^{-11} torr vacuum preceding each data point determination in an automatically timed sequence. The measured standard deviation of the emission current common logarithm was 0.019, inclusive of all process and measurement uncertainties. All data runs showed a hitherto unreported upward-then-downward deviation from linearity on conventional log I vs 1/V plots. Changing the dependent variable to log (I/V^2) removed the double inflection and extended linearity to current density 1–3 x 10^6 A/cm^2. A well defined monotonically downward deviation from linearity occurred at all larger current densities. Appropriateness of the log (I/V^2) variable was interpreted as experimental verification of a corresponding dependency in the Fowler–Nordheim theoretical equation. The general data trends were slightly but significantly different from those of Dyke and Trolan (Phys. Rev. 89, 799 (1953)). Current densities at critical points were smaller and the downward deviations from linearity were better defined. (Diss. Abstr. Int., B)

20804 CALORIMETRIC STUDIES OF STRONG-COUPLING, TYPE-II SUPERCONDUCTIVITY IN SUPERSATURATED LEAD–TIN ALLOYS AND IN LEAD–BISMUTH ALLOYS. Park, J. C. Boston; Northeastern Univ. (1975). 217p. University Microfilms Order No. 75-28,890.

Thesis (Ph. D.).

Calorimetric measurements were made for normal, superconducting, and mixed supersaturated alloys of lead with up to 20 at. percent tin, and of Pb–Bi alloys at 1.3 to 8^0K. Parallel measurements of residual resistivity and magnetization were also made. Electronic specific heats, thermodynamic critical field, and generalized Ginzburg–Landau parameters were determined along with the effective Debye temperature, T/sub c/ and the thermodynamic critical field at 0^0K increase for both Pb–Sn and Pb–Bi. Electronic and thermodynamic properties for Pb–Sn alloys, when expressed in reduced terms, are virtually the same as pure lead, and these alloys may be regarded as strong-coupling, type-II materials with essentially the same electronic properties as pure lead. The thermodynamic behavior of the Pb–Sn alloys is in good agreement with strong-coupling theory. Equally good agreement was found for the Pb–Bi alloys, which are slightly stronger coupling superconductors. Kappa (1) and $kappa_1(t)$ are in good agreement with Rainer and Bergmann calculations based on the Eliashberg theory, but $kappa_2(t)$ shows substantial disagreement with Rainer and Usadel calculations. These discrepancies may be due to linearization of the Eliashberg equations in presence of magnetic field. Comparison of the McMillan equation for T/sub c/ and measured values for Pb–Sn suggests that localized phonon modes exist in this system. This study shows that the Debye temperature (at T equals 0) for lead alloys may be a simple function of the residual resistivity regardless of the solute, provided that the concentration is not too high. (DLC)

20805 QUASIPARTICLE INTERFERENCE PHENOMENA IN SUPERCONDUCTING CADMIUM FILMS. Colucci, S. L. Notre Dame, IN; Univ. of Notre Dame (1975). 175p. University Microfilms Order No. 75-19,927.

Thesis (Ph. D.).

Bound states and virtual states were observed in the tunneling characteristics of thick Cd films deposited over Pb. Amplitude effects displaying a temperature dependence not previously reported were also observed. These observations are explained in terms of a proposed interpretation of Wolfram's theory. Level spacings are employed to obtain a Fermi velocity v/sub F/ (c-axis) equals 1.30 x 10^8 cm/s which is in good agreement with the magnetic surface state value. Amplitudes and level spacings appear to show some promise of yielding useful proximity-effect information. Previous tunneling studies with Zn (done elsewhere) which were thought to yield anomalous results, are reconciled in terms of the present interpretation. (Diss. Abstr. Int., B)

20806 LOW TEMPERATURE HYDROGEN EMBRITTLEMENT IN NIOBIUM. Grossbeck, M. L. Urbana, IL; Univ. of

Illinois (1975). 206p. University Microfilms Order No. 75-24,312.

Thesis (Ph. D.).

An experimental study of hydrogen embrittlement in niobium was conducted at temperatures from 115 to 300°K in alloys containing from 0.15 to 5.5 at. percent hydrogen to determine the mechanism of embrittlement. In situ crack propagation studies were made in a scanning electron microscope equipped with a video tape recorder and a tensile cold stage designed for the project. Detailed fractographic studies were made in conjunction with the propagation experiments. Although necking and slip bands testify to extensive plastic deformation in the matrix, fracture surfaces exhibited complete cleavage. All characteristics of the fracture were found to be consistent with the formation of a local, brittle, stress-induced niobium hydride phase at the tips of cracks above the stress-free solvus temperature. The existence of this phase was confirmed by an electron diffraction structure determination and also by an ion microprobe study in which mass analyzed images and point analyses showed greatly enhanced NbH^+ and H^+ signals, typical of NbH, in the crack zone. (Diss. Abstr. Int., B)

20807 NUCLEAR MAGNETIC RESONANCE IN FERROMAGNETIC TERBIUM METAL. Cha, C.L.T. Columbia, MO; Univ. of Missouri (1974). 201p. University Microfilms Order No. 75-20,100.

Thesis (Ph. D.).

The magnetic properties of terbium were studied by the method of zero field nuclear magnetic resonance at 1.5 to 4 and 85 to 160°K. Two unconventional experimental techniques have been employed: the swept frequency and the swept temperature technique. Near 4°K, triplet resonance line structures were found and interpreted in terms of the magnetic domain and wall structures of ferromagnetic terbium. In the higher temperature range, temperature dependence of the resonance frequency and the quadrupole splitting were measured. The former provides a measurement of the temperature dependence of the magnetization M, and it agrees with bulk M measurements as well as the latest spin wave theory of M(T) (Brooks 1968). The latter agrees well with a calculation using a very general single ion density matrix for collective excitations (Callen and Shtrikman 1965). In addition, the small temperature-independent contribution to the electric field gradient at the nucleus due to the lattice and conduction electrons was untangled from the P(T) data. Also an anomalous and unexplained relaxation phenomenon was also observed. (Diss. Abstr. Int., B)

20808 SUPERCONDUCTIVITY IN METAL-SEMICONDUCTOR EUTECTIC ALLOYS. Johnson, W. L. Pasadena, CA; California Inst. of Tech. (1975). 99p. University Microfilms Order No. 75-19,997.

Thesis (Ph. D.).

The superconductivity of several metal–semiconductor simple eutectic alloys containing Ge or Si, and one of the metals Al, Be, In, Pb, Sn, or Tl was investigated. The liquid-quenching technique was used to reduce the characteristic scale of the microstructure in the alloys. It was found in some cases (notably Al-base alloys) that the superconducting transition temperature of the metallic phase was significantly enhanced (from 1.2°K to approximately 6°K for Al-base alloys) as a result of liquid-quenching. The characteristic scale of the microstructure was found to be of the order of several hundred Angstroms in alloys showing the greatest enhancement effect. Results are discussed in terms of recent theoretical models that predict enhancement of superconductivity due to electronic interactions at a metal–semiconductor interface. Results are also analyzed in terms of the McMillan theory of superconductivity in which the enhancement effect is attributed to a reduction in the characteristic phonon frequencies of the metal. It is concluded that the latter explanation can account for all of the observed properties and, thus, that it is probably unnecessary to invoke an "excitonic mechanism" to explain the results. (Diss. Abstr. Int., B)

20809 INTERACTION OF POSITRONS WITH ATOM CHAINS OF NIOBIUM IN Nb_3Al. Alekseevskii, N. E.; Krasnoperov, E. P.; Sedov, V. L. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 222: No. 5, 1061-1063(11 Jun 1975). (In Russian).

The electron structure of Nb_3Al was investigated by a positron annihilation method. It is known that the superconducting transition temperature varies with a change in the degree of atomic order. This study follows the effect of the angular correlation of annihilation radiation in polycrystalline samples of Nb_3Al with various modes of thermal treatment. First measurements were carried out on samples obtained by rapid crystallization. Then the measurements were repeated on the same samples after annealing at 700°C over a period of 5 days. Measurements of the effect of the angular correlation of annihilation radiation were obtained by the use of plane-parallel slits. The count rate of annihilation gamma quanta were obtained as a function of angle. The count rate is related by a simple relation to the electron distribution density in momentum space. It is shown that the position of the Fermi surface with respect to the zone boundaries has an effect on the angular correlation of annihilation radiation. (SJR)

20810 SUPERCONDUCTIVITY AND STRUCTURE OF ALLOYS IN THE VANADIUM–NIOBIUM–TANTALUM SYSTEM. Sirota, N. N.; Shimanskaya, N. M. (Inst. of Solid State Physics and Semiconductors, Minsk). Dokl. Akad. Nauk SSSR; 222: No. 5, 1089-1092(11 Jun 1975). (In Russian).

The structure, microhardness, and lattice constants of V–Nb–Ta alloys were investigated and their transition temperatures to the superconducting state were determined. The alloys were held at 1350°C for 96 hours, and cooled rapidly to 800°C. The changes in microhardness, lattice constants, and transition temperature are plotted on triangular composition diagrams. The transition temperature decreases on going from the niobium corner of the concentration triangle towards binary alloys of the V–Ta system. A minimum also occurs in binary V–Nb alloys. (SJR)

20811 EFFECT OF LOW-TEMPERATURE ANNEALING ON THE PROPERTIES OF InSb. Tsitsina, N. P.; Fadeeva, A. P.; Vdovkina, E. E.; Baryshev, N. S.; Aver'yanov, I. S. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 716-718(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 835-838(May 1975).

Results of annealing N- and P-type InSb specimens in Ar at 200°C for 6 days are presented. It was found that the annealing does not induce inversion of conductivity in n-type InSb; it heightens the carrier concentration and reduces the resistivity in both n- and p-type specimens, these changes being more pronounced in n-type material. The existence of a level at a distance of 0.15 to 0.17 eV from the top of the valence band in unannealed InSb specimens was confirmed. This is an acceptor level and disappears during high-temperature annealing. Low-temperature annealing has practically no effect on the lifetime in p-type specimens, but leads to an increase in the lifetime of n-type specimens. (auth)

20812 SPECTROSCOPIC INVESTIGATION OF CRYSTALS WITH THE GARNET STRUCTURE. Kaminskii, A. A.; Bogomalova, G. A.; Kevorkov, A. M. (Inst. of Crystallography, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 757-761(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 884-869(May 1975).

The possibilities of compounds with the garnet structure are examined from the viewpoint of finding new laser crystal matrices. In discussing this important problem new spectral-generation data are presented on a large number of garnets containing Nd^{3+} ions. (auth)

20813 DIFFUSION OF IMPURITIES IN SEMICONDUCTIVE BORON. Panteleeva, G. V.; Karimov, R. Kh. (Inst. of Electronics, Tashkent). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 5, 806-807(May 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 5, 943-944(May 1975).

Diffusion of Au, Ag, and W in B at 900 to 1250°C was studied. It was found that most diffusion occurs at the crystallite boundaries causing measured values of diffusion to be a structure-sensitive parameter, dependent on many difficult-to-control factors. (JRD)

20814 THERMAL AND ELECTRICAL CONDUCTIVITIES OF NIOBIUM–65% TITANIUM ALLOYS. Morton, N.; James, B. W.; Wostenholm, G. H.; Nuttall, S. (Salford Univ., Eng.). J. Phys., F (London); 5: No. 11, 2098-2104(Nov 1975).

The thermal and electrical conductivities of samples of as-rolled and annealed 35% Nb–65% Ti alloy were measured between 4 and 20°K and between the superconducting critical temperature and 270°K respectively. Analysis shows that the thermal conductivity is almost entirely due to phonon carriers, with the magnitude primarily limited by electron-phonon scattering by an unusually small number of electrons. The electrical resistivity data are analysed to show that s-d interband scattering occurs most frequently. The enhancement of the electrical conductivity due to the existence of short-range superconducting order above the bulk critical temperature is discussed. (auth)

20815 ISOMER SHIFTS IN GADOLINIUM COMPOUNDS HAVING THE CAESIUM CHLORIDE STRUCTURE. Ross, J. W.; Sigalas, J. (Manchester Univ., Eng.). J. Phys., F (London); 5: No. 10, 1973-1980(Oct 1975).

The isomer shifts of the 86.5 keV γ ray of ^{155}Gd in cesium chloride type pseudobinary compounds of Gd with Ag, In, Cu and

Ga were measured. It is proposed that as group IIIB elements replace IB elements, the density of s-like electrons in the conduction band decreases. (auth)

20816 MODULUS OF ELASTICITY OF ALLOYS WITH COMPONENTS FORMING MECHANICAL MIXTURES. Glikman, L. A.; Kartashov, A. M.; Rubashkina, Z. M.; Lobov, A. F. (Leningrad Inst. of Precision Mechanics and Optics). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 398-399(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 5, 34-35(May 1975).

The dependence of the elastic modulus on composition was determined for five alloy systems: Bi–Cd, Bi–Sn, Al–Si, Al–Be, and Fe–Fe_3C. The relation is fairly well expressed by a straight line. (DLC)

20817 STRUCTURAL AND PHASE TRANSFORMATIONS IN ALLOY 80N2M WITH SULFUR. Levinzon, V. Kh.; Putimtsev, B. N.; Leskov, B. A. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 400-403(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 5, 35-38(May 1975).

In the process of heating alloy 80N2M (80.8% Ni, 2.43 Mo, 0.019 S, remainder Fe) to temperatures above 1200°C, the sulfides located in grain boundaries go into solution in the metallic matrix. This process is most complete at 1250–1350°C. Heating above 1300°C leads to considerable oxidation of the alloy in the grain boundaries and impairs the plasticity. The nucleation of new grains in the process of hot rolling occurs at the boundaries of columnar crystals of the original cast structure. The largest size of recrystallized grains corresponds to the region of transition from partial retention of the cast structure to complete recrystallization. The number of sulfide inclusions in the bulk of new recrystallized grains is smaller than in the cast matrix, which indicates redistribution of sulfur between the bulk of the grains and the grain boundaries in the process of recrystallization. We determined the effect of rolling conditions, cooling rate of the strip after deformation, and the final rolling temperature on the formation of fine-grained structure in hot rolled strips. (auth)

20818 IMPACT-ABRASION WEAR RESISTANCE OF HIGH-CHROMIUM CAST IRON. Kitaigora, N. I. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 417-420(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 5, 49-53(May 1975).

The effect of Mo, Ni, V, W, and Ti on the size and shape of carbides, matrix structure, and heat treatability of high-Cr cast irons was investigated. Wear resistance is greatest for cast irons with 3.8–4.2% C, 14–18% Cr, 0.6–1.0% Ni, 1.5–3.5% V, 4–10% Mo, and 0.3–0.6% Ti. (DLC)

20819 SIZE OF EXCESS CARBIDES IN HIGH-SPEED STEELS. Sedov, Yu. E.; Geller, Yu. A.; Kremnev, L. S.; Gordesiani, A. G. (Moscow Machine-Tool Inst.). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 458-462(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 6, 4-9(Jun 1975).

The number of large carbides (over 9 μ), commensurate with the radius of curvature of the cutting edge, increases with the weight of the ingot, especially in the case of high-tungsten steel R18, which is the result of the solidification conditions. Reducing the tungsten content and adding molybdenum induce refining of the carbides. In deformed tungsten–molybdenum steel R6M5, the number of large carbides is only half that in steel R18. Nevertheless, the number of large carbides remains substantial in steel R6M5 obtained from large ingots (550 kg and larger). The degree of deformation, which has a large effect on the distribution of carbides (carbide heterogeneity), has almost no effect on the size of carbides. For the production of high-speed steels rolled to small sections (diameter up to 20 mm) it is recommended that the ingot weigh 100-150 kg. (auth)

20820 RED HARDNESS OF HIGH-SPEED STEELS. Smol'nikov, E. A.; Orestova, L. M. (All-Union Scientific-Research Tool Inst., Moscow). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 467-470(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 6, 13-17(Jun 1975).

The red hardness of high-speed steels can be determined from the hardness retained after additional heating at 675°C for 20 or 30 min directly after quenching–criteria RH_{30}^{675} and RH_{60}^{675}, which give numerically the same values as RH_1^{620} but require less time. These values can be used together with others (austenite grain size, hardness) to judge the quality. In increasing order of red hardness, the steels investigated are arranged in the same order in which the alloying of the solid solution changes due to the chemical composition, original structure, and quenching temperature. (auth)

20821 EFFECT OF CARBON, SILICON, AND COBALT ON STRUCTURE AND PROPERTIES OF STEELS FOR COLD DEFORMATION. Skrynchenko, Yu. M.; Poznyak, L. A.; Koval'chuk, A. V. (Scientific-Research Inst. of Special Steels, Alloys, and Ferroalloys, Kharkov). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 471-474(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 6, 17-20(Jun 1975).

Additional alloying of steel 8Kh4V2S2MF with silicon and cobalt leads to an increase of the resistance to small plastic deformation due to intensification of secondary hardening processes and strengthening of the matrix. With addition of more than 3% Mo the toughness and the bending strength are lower than in steels additionally alloyed with silicon alone, which can be explained by the more heterogeneous decomposition during tempering. Steel of the Kh4V2F2M type alloyed with 3–4% Si has a good combination of resistance to compression ($\sigma_{0.5}^{comp} \sim 250$ kg/mm^2, $\sigma_{0.2}^{comp} \geq 300$ kg/mm^2) and bending strength ($\sigma_{bend} \sim 380$ kg/mm^2) and can be used for dies operating under pressures up to 250 kg/mm^2. (auth)

20822 EFFECT OF HEAT TREATMENT ON CONDITIONS OF FORMATION, SHAPE, AND STABILITY OF VANADIUM CARBIDES IN VANADIUM STEELS. Rakhshtadt, A. G.; Lanskaya, K. A.; Suleimanov, N. M.; Katkova, L. V. (Moscow Technical Coll.). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 477-480(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 6, 23-27(Jun 1975).

It was found that the structure of steels 22F1B, 27F1B, and 35F2B resulting from isothermal transformation of supercooled austenite at 680–720°C consists of evenly distributed high-strength, oriented, dispersed vanadium carbide in a ferrite matrix. Such vanadium carbides impart high strength at normal and elevated temperatures, while ferrite provides fairly high ductility. The structure of the steels after the double heat treatment (normalization at 1130°C for 5 min, tempering at 720°C for 3h) consists of ferrite and unevenly distributed vanadium carbides. The strength characteristics at normal and elevated temperatures are lower than after the isothermal treatment at 680–720°C for 30 min. The original structure of the steel after quenching or after isothermal treatment has different effects on the hardness during subsequent tempering. Tempering at 400–450°C after quenching or incomplete decomposition of supercooled austenite leads to reduction of the hardness due to coalescence of cementite, while complete decomposition of austenite, with formation of a ferrite-carbide structure, leads to an increase in hardness beginning at very low temperatures. (auth)

20823 GRAIN BOUNDARY SLIP IN POLYCRYSTALLINE BERYLLIUM. Karpov, E. S.; Papirov, I. I.; Tikhinskii, G. F. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 495-499(1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 6, 40-44(Jun 1975).

Grain boundary slip was investigated in polycrystalline beryllium of commercial purity. It was found that ϵ_{gb} is directly proportional to the total deformation, i.e., $\epsilon_{gb} = \gamma\epsilon\Sigma$. The value of γ varies in a complex manner with the deformation temperature. It is proposed that the reduction of γ at 500°C is due to formation of precipitates in grain boundaries resulting from strain aging. A substantial role in the process of grain boundary slip is played by Nabarro–Herring creep, which is capable of accommodating deformation without slip in neighboring grains. (auth)

20824 TEXTURE OF NIOBIUM BANDS. Borodkina, M. M.; Chusova, G. F.; Gruznov, Yu. A.; Fedotov, L. N. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 5-6, 540-542 (1975).

Translated from Metalloved. Term. Obrab. Met.; 17: No. 6, 77-79(Jun 1975).

The deformation texture of niobium bands (11-26 μ thick) consists of ideal components {100} ⟨011⟩, {113} ⟨011⟩, and {112} ⟨011⟩. Alloying with 0.05% Ti and 0.5% Zr weakens the deformation texture and changes the quantitative ratio of the components slightly, the first becoming stronger. The recrystallization texture of niobium (annealed at 1200–1500°C) consists of components {100} ⟨320⟩. Alloying changes the recrystallization texture of niobium–after annealing at 1200°C the texture of alloyed niobium repeats the deformation texture, with a considerably stronger {100} ⟨011⟩ component. New components occur after annealing at 1500°C–a strong {140} ⟨351⟩ component and weak {113} ⟨120⟩ –6°C component. (auth)

20825 EFFECT OF PRESSURE ON SELF-DIFFUSION IN bcc GAMMA-YTTERBIUM. Fromont, M. (CEN, Fontenay-aux-Roses, France). J. Phys. Chem. Solids; 36: No. 12, 1397-1400 (Dec 1975). (In French).

The pressure effect on the self-diffusion rate has been studied in bcc γ-ytterbium. The experiments were performed at three different temperatures: 730, 760, and 800°C, and under hydrostatic pressure varying from 4.5 to 10 kbar. The activation volume is determined to be 0.59 vol. mol. This value agrees with semi empirical models and suggests the vacancy mechanism for diffusion. (auth)

20826 SEPARATION AND IDENTIFICATION OF PHASES WITH THROUGH-FOCUS DARK-FIELD ELECTRON MICROSCOPY. Rao, P. (General Electric Co., Schenectady, NY). Philos. Mag.; 32: No. 4, 755-762(Oct 1975).

The use of out-of-focus dark-field images combined with stereoviewing to obtain more information than is available from a single dark-field image and its corresponding diffraction pattern, has been demonstrated recently. In this technique, called through-focus dark-field electron microscopy, an artificial stereo-image effect can be produced by utilizing the image shifts in out-of-focus dark-field images. The technique basically involved obtaining two beam-tilted dark-field images, selecting several spots with the objective aperture, such that one image is slightly over-focus and the other slightly under-focus. Examination of the two images through a conventional stereoviewer produces elevation differences between regions contributing to the several spots chosen with the objective aperture. These elevation differences are unrelated to object positions in the thin foil, and no specimen tilting is required. Applications of this technique to rapid separation and identification of phases in complex alloy systems are discussed. (auth)

20827 STRUCTURES OF 3d-TRANSITION METALS IN THE LIQUID STATE. Waseda, Y.; Tamaki, S. (Tohoku Univ., Sendai). Philos. Mag.; 32: No. 2, 273-281(Aug 1975).

The structures of 3d-transition metals (Ti, V, Cr, Mn, Fe, Co, Ni and Cu) in the liquid state were systematically examined by x-ray diffraction at temperatures above their melting points. In terms of the usual Fourier analysis, the atomic radial distribution functions were obtained from which interatomic distance and coordination number were estimated. (auth)

20828 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF NIOBIUM–TITANIUM–COPPER ALLOYS. Savitskii, E. M.; Baron, V. V.; Frolov, V. A. pp 60-64 of Splavy Redk. Met. s Osobymi fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

Studies were made of the structure and superconducting properties of Nb–Ti–Cu alloys with Nb : Ti = 2 : 3 and 1 : 3, and Cu ≤ 8.5 at. %, and also of those of an isothermal section at 700°C of the Ti corner of the diagram. In alloys containing Cu in amounts greater than the solubility limit, inclusions of a non-superconducting phase form in the β solid solution. These inclusions consist of the compound Ti_2Cu, and lead to an appreciable increase in the critical c.d. (Metals Abstr.)

20829 GRAIN-BOUNDARY SLIDING DURING DIFFUSIONAL CREEP. Aigeltinger, E. H.; Gifkins, R. C. (Commonwealth Scientific and Industrial Research Organization, Melbourne). J. Mater. Sci.; 10: No. 11, 1889-1903(Nov 1975).

Grain-boundary sliding and diffusional changes at grain boundaries were monitored on the surface and in the interior of a magnesium alloy Magnox ZR55 tested under diffusional creep conditions. The behaviour is compared and contrasted to that observed under recovery creep conditions. It was found (i) that diffusional and recovery creep exhibit distinctively different angular dependencies of grain-boundary sliding, (ii) that the surface and interior grains exhibit the same sliding and diffusional changes (in the plane of the surface) under diffusional creep conditions, (iii) that a previously presented method for the measurement of diffusional creep (E. H. Aigeltinger, J. Mat. Sci.; 9: 644 (1974)), when modified as described here, allows the determination of diffusional and sliding components for samples with either as-cut or annealed surface conditions, and (iv) that under diffusional creep conditions the value of γ is 0.5. (auth)

Radiation Effects

Refer also to abstracts 21099, 21808, 21981, 22002, 22005, 22109, 22110, and 22112.

20830 (CEA-R-4707) LOW TEMPERATURE IRRADIATION CREEP OF TUNGSTEN AND MOLYBDENUM. Pouchou, J. L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Dec 1975. 141p. (In French). Dep. NTIS (US Sales Only) $6.00.

Thesis. Submitted to Poitiers Univ., France.

It is demonstrated that the mechanism of stress biased nucleation of dislocation loops may contribute significantly to the low-temperature irradiation creep. This is achieved by measuring length and electrical resistivity changes at liquid hydrogen temperature, under fission fragments bombardment. From these measurements (correlated with some electron microscopy observations of irradiated samples), the following three stages of deformation appear: at low doses (smaller than 10^{-2} dpa), the deformation is mainly an increase in volume due to point defects. The study of this stage gives the formation volume of a Frenkel pair, and the number of point defects created by an initial fission fragment; for doses higher than 10^{-2} dpa, the point defects saturation is reached. At this stage, vacancies and interstitials collapse into loops, the nucleation of which is polarized by the applied stress. At zero stress, the corresponding creep rate is zero. At high stresses (> 50 kg/mm²), creep rate saturates at a value of the order of 10^{-21} $(FF/cm^3)^{-1}$; because of the recombinations of loops, the creep rate decreases continuously during irradiation. The recombinations lead to a dense dislocation network (formed at doses of 1 dpa), the climb of which oriented by the applied stress gives rise to a steady state creep. The creep rate is smaller, by at least one order of magnitude, than that observed in the stage of loops formation. (auth)

20831 (CNLM-4029) ACTIVATION DOSE RATES FROM SYSTEM COMPONENTS. Smolen, J. R. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 4 Apr 1962. Contract AT(30-1)-2789. 2p. Dep. NTIS $3.50.

Computations of posttest dose rates from activated materials comprising system components and support structure are summarized. (DLC)

20832 (CNLM-4225) SUMMARY OF METALLOGRAPHIC STUDIES AND URANIUM ISOTOPIC ANALYSIS OF IRRADIATED URANIUM–YTTRIUM ALLOYS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1962. Contract AT(30-1)-2789. 26p. Dep. NTIS $4.00.

Results of metallographic examination and U isotopic analysis of irradiated U–Y fuel alloys are presented. Data are included on sample compositions, design operating conditions, and burnup. Micrographs of fuel specimens are also included. (JRD)

20833 (CONF-751160-2) RADIATION-ENHANCED DIFFUSION IN METALS AND ALLOYS. Lam, N. Q.; Rothman, S. J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 36p. Dep. NTIS $4.00.

From ASM seminar on materials science; Cincinnati, United States of America (USA) (9 Nov 1975).

Some phenomena that involves diffusion during irradiation include fission-product redistribution in reactor fuels, defect clustering in CTR walls or fast-reactor cladding, smearing-out of gradients in ion-implanted semiconductors, and microstructure development in a HVEM. This paper is a review of the basics of radiation-enhanced diffusion (REM). The present status of REM today is somewhat the same as diffusion in the 1940's, and recommendations are made for further work. 105 references. (DLC)

20834 (CONF-751160-3) THEORY OF DEFECT CLUSTERING AND VOID FORMATION. Wiedersich, H. (Argonne National Lab., Ill. (USA)). 1975. 41p. Dep. NTIS $4.00.

From ASM seminar on materials science; Cincinnati, United States of America (USA) (9 Nov 1975).

This paper reviews the current understanding of the mechanisms and phenomena that form voids and dislocation structures as a consequence of displacement damage and concurrent annealing processes which tend to restore thermodynamic equilibrium. An attempt is made to provide a qualitative explanation for the effects of parameters on void formation and on the development of the dislocation structure during irradiation. Steady-state conditions, nucleation, swelling, and sink-annihilation probabilities are discussed. 75 references. (DLC)

20835 (COO–1367-63) MECHANICAL EFFECTS OF ELECTRON IRRADIATION IN IRON SINGLE CRYSTALS. Meshii, M.; Sato, A. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Materials Science and Engineering). 1976. 7p. (CONF-751006–24). Dep. NTIS $3.50.

From international conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

Electron irradiation (2 MeV, up to 6 x 10^{18} e/cm²) decreased the yield stress of iron single crystals in the temperature range from 4.2 to 80°K. The softening effect was highly dependent on the tensile axis orientation. The temperature and strain rate dependency of the yield stress was increased by the irradiation. The annealing of the softening took place between 90 and 150°K.

The observation is consistent with an intrinsic solid solution softening mechanism based on the enhancement of screw dislocation motion due to dispersed interstitials. (auth)

20836 (COO-1367-73) EFFECT OF POINT DEFECTS ON MECHANICAL PROPERTIES OF METALS. Progress Report, January 1, 1975–December 31, 1975. Meshii, M. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Materials Science and Engineering). Dec 1975. Contract AT(11-1)-1367. 12p. Dep. NTIS $3.50.

Results of research activities are presented on electron irradiation softening in pure Fe, effects of impurities on electron irradiation softening, electron microscopic investigation of electron irradiation softening, surface film softening, and dislocation motion. (JRD)

20837 (LBL-3922) CLIMB OF PRISMATIC LOOPS IN Cu–Al ALLOYS DURING IRRADIATION IN THE HVEM. Kosel, T.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 8p. (CONF-751006-25). Dep. NTIS $3.50.

From international conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

Nucleation and growth of prismatic interstitial loops was observed during irradiation in the HVEM at different temperatures and damage rates. The loops remained rhombus shaped throughout growth, with sides lying on (111) planes, suggesting low jog densities. Weak-beam electron micrographs showed that the loops were dissociated on the (111) planes containing the loop sides. A minimum damage rate, PHI/sub min/, was found to be necessary to induce growth at measurable rates. This, together with the low jog densities observed, was taken to indicate that the climb rate was affected by the rate of jog nucleation, rather than controlled entirely by the rate of diffusion of point defects to the dislocations. PHI/sub min/ was found to be smaller for alloys of higher stacking fault energies, probably due to the influence of stacking fault energy on the energy of jog formation on an extended dislocation. The growth rate was found to be constant for individual loops observed over a large size range, suggesting that jog nucleation occurred preferentially at loop corners. (auth)

20838 ELASTIC AND PLASTIC PROPERTIES OF IRRADIATED METALS. Quere, Y.; Leteurtre, J. Ann. Mines; 2: 87-98 (1975). (In French)

Crystal lattice defects caused by irradiation of metals with electrons, ions, neutrons, and α particles, are described. Their effects on mechanical properties, mainly hardening, embrittlement, and increased susceptibility to creep, are discussed. (Metals Abstr.)

20839 EFFECT OF RADIATION DEFECTS ON THE ELECTRICAL RESISTANCE OF TUNGSTEN SINGLE CRYSTALS. Bykov, V. N.; Birzhevoy, G. A.; Zakharova, M. I.; Solov'ev, V. A. pp 159-160 of Splavy Redk. Met. S Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974).

Electrical resistance, ρ, measurements at 4.2, 77, and 298°K were made of single crystals of W irradiated at 450 to 500°C with 1.4×10^{22} neutron/cm^2. After annealing in the range 200 to 2200°C there were three stages of reduction in ρ that corresponded to three types of radiation damage with activation energies of 0.70 ± 0.03, 3.2 ± 0.3, and 6.4 ± 0.5 eV, respectively. An irreversible change in ρ is caused by the build-up of Re and W as a result of (n,γ) reactions. (Metals Abstr.)

20840 ANISOTROPY OF DIA-ELASTIC MODULUS CHANGE IN ALUMINUM SINGLE CRYSTALS AFTER ELECTRON IRRADIATION AT 4.2°K. Robrock, K. H.; Schilling, W. (Kernforschungsanlage, Juelich, Ger.). pp 233-238 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

Introduction of interstitials into a crystal gives a strong decrease of shear moduli, indicating that the atomic configuration around the interstitial is highly polarizable under shear. This polarizability is anisotropic and much larger for a 100-shear than for a 110-shear. The high polarizability can be understood if the interstitial has a 100 dumbbell configuration and the springs around the defect are highly compressed. These negative leaf springs nearly cancel the effect of the other positive springs around the defect, making the lattice very soft for certain shear deformations. The anisotropy of this polarizability is connected directly with the symmetry of the defect. Comparison between the theoretical and the experimental result suggests that the interstitials must have the 100-dumbbell configuration. The small restoring forces for a 100-shear of the interstitial should result also in very low eigenfrequencies if the corresponding modes are excited dynamically. Since low frequency modes can be excited to rather large amplitudes at low temperatures, the existence of such low frequencies explains why interstitials in fcc metals become mobile at low temperatures. (auth)

20841 DEFECT DRAGGING BY DISLOCATIONS. Theory and Experiment in the Amplitude Independent and Dependent Regions. Sosin, A. (Univ. of Utah, Salt Lake City). pp 109-133 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (Ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

In the theory of "defect dragging", account is made for the contributions to internal friction (decrement) and to elastic moduli by the dragging of point defects attached to dislocation lines as the dislocation segments are bowed by an applied stress. Experiments are also reviewed. The dragging model accounts for the observed frequency dependence of decrement in the low (few kHz and below) frequency range. The model also predicts the initial increase in decrement (peaking effect) found on bombardment in copper, aluminium, and probably tungsten. The peaking effect, a function of temperature of irradiation and pre-irradiation sample history, is vividly present in copper, concomitant with a rapid, monotonic decrease in the modulus defect–as predicted by the dragging model. In aluminium, the increase is substantially slower and, at cryogenic temperatures above 78°K, the modulus defect shows very little variation. These observations in aluminium are also consistent with the dragging model. In fact, copper and aluminium samples that have been studied provide support for the dragging model in different value ranges of a universal parameter which includes frequency of measurement, damping constants for dragged point defects and dislocation segments, dislocation loop length, and dislocation line tension. (auth)

20842 NATURE OF "DISLOCATION PINNING" BY RADIATION INDUCED DEFECTS, WITH PARTICULAR REFERENCE TO THE SIMPSON–SOSIN PEAK. Seeger, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 232-245 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

The paper develops a physical picture of the interaction between point defects and dislocations as studied by measurements of the internal friction and the elastic modulus defect. The case of a defect with ⟨100⟩ - symmetry that is capable of both rotational and migrational jumps is used to illustrate the general ideas. Particular emphasis is laid on the effects of the long-range interaction between point defects and dislocations. These are contrasted with the usual dislocation-pinning description. The theoretical conclusions are compared with experiments on cold-worked and irradiated nickel and copper. On the basis of internal friction, modulus defect, and relaxation experiments it is shown that in these metals the self-interstitial atoms may give rise to a Snoek effect, exist in a ⟨100⟩ - dumbbell configuration, and migrate with an activation energy corresponding to that of the well-known annealing stage III. An earlier interpretation of the recovery stages of fcc metals is thus confirmed in an independent way. It is shown that the present results lead to a natural explanation of the Simpson–Sosin peak in irradiated metals including its strong temperature dependence. (58 refs) (auth)

20843 ANALYSIS OF DISLOCATION PINNING. Schindlmayr, R.; Luecke, K. (Technische Hochschule, Aachen). pp 255-264 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

Electron or γ irradiation of metals causes dislocation pinning, and the pinning curve (number of pinning points/volume vs irradiation time) has three parts: an initial transient part, a linear part, and a part with decreasing slope. In this paper, a model is given for the interpretation of the three parts. (DLC)

20844 ANALYSIS OF DISLOCATION PINNING EXPERIMENTS IN COPPER. John, R.; Lenz, D.; Luecke, K. (Technische Hochschule, Aachen). pp 265-275 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

Some pinning experiments on irradiated copper cannot be explained using Thompson's model, unless the model is extended with at least two additional reservoirs. (8 figs)

20845 DISLOCATION DAMPING IN Cu AT kHz- AND MHz-FREQUENCIES. Naundorf, V.; Luecke, K. (Technische Hochschule, Aachen). pp 281-287 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

Measurements of MHz damping, kHz damping, and modulus change were made on γ-irradiated Cu. The effects can be explained by the Granato-Luecke (G.L.) theory. The damping constant derived from the kHz measurements is about 10 times larger than that from MHz damping. The loop lengths are different by a factor of 1.5, but the number of irradiation-induced pinning points is the same in both frequency ranges. Results indicate that the G.L. theory describes the loop length dependence and the frequency dependence in the MHz range but not in the kHz range. (DLC)

20846 INTERNAL FRICTION OF NIOBIUM IRRADIATED AT LOW TEMPERATURES. Igata, N.; Watari, F.; Yamaguchi, A.; Miyahara, K.; Sato, S. (Tokyo Univ.). pp 297-304 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

The α peak is suppressed by neutron irradiation below 6.8×10^{16}n/cm^2 (>1 MeV), owing to the pinning effect of free migrating point defects which are produced by low temperature irradiation. The α peak changes more sensitively in the case of low temperature irradiation than in the case of room temperature irradiation, suggesting that annealing occurs in the latter case. The β_1 and β_2 peaks are also sensitive for irradiation doses. The maxima of the β_1 and β_2 peaks were observed versus irradiation dose and interstitial impurity contents. The α peak could be interpreted by double kink formation mechanisms. The β_1 and β_2 peaks would be due to a similar mechanism. The β_1 and β_2 peaks would be due to the interaction between dislocations and point defects. (auth)

20847 OBSERVATION OF EXTRINSIC INTERNAL FRICTION PEAKS IN DOPED ALUMINIUM NEUTRON-IRRADIATED OR COLD-WORKED AT LOW TEMPERATURES. Grynszpan, R. (Centre d'Etudes de Chimie Metallurgique, Vitry, France). pp 432-438 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P2.

In order to study interactions between point defects and impurities, internal friction measurements in the 1 cycle frequency range were made on Cu-doped Al after fast neutron irradiation down to 20°K. Some cold work experiments were also done. Possible mechanisms for relaxation by the point defect-impurity complexes are discussed. (DLC)

20848 RANGE AND DISTRIBUTION OF Gd IONS IMPLANTED IN Nb THIN FILMS. Scholten, P.D.; Skokan, M.R.; Kemper, K.W.; Moulton, W.G. (Department of Physics, Florida State University, Tallahassee, Florida 32306). Phys. Rev. B 13: No. 1, 42-44 (1 Jan 1976).

The range and distribution of Gd ions implanted in Nb thin films over a range of implantation energies from 50 to 150 keV has been measured. The ranges and distributions were obtained by determining the energy loss of backscattered 24-MeV ^{16}O ions. The results show that the projected range of the implanted ions is about a factor of 2 shorter than predicted by the Lindhard, Scharff, and Schiøtt theory, and that the distribution is not Gaussian. (auth)

20849 DRIFT MOBILITY OF HOLES IN *n*-TYPE GERMANIUM BOMBARDED BY FAST NEUTRONS. El-Difrawi, A.A.; Yeh, T.H.; Christopher, J.E.; Gossick, B.R. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). J. Appl. Phys. 47: No. 1, 272-276 (Jan 1976).

A surface effect which depends on exposure to fast neutrons is introduced. This effect makes the apparent drift mobility of holes in germanium increase under certain conditions following irradiation by fast neutrons, but the bulk mobility never increases. Thus, contrary to a simple model for disordered regions in *n*-type germanium, these regions do not act like short circuits for holes. (auth)

20850 ELASTIC INTERACTIONS BETWEEN "VOIDS" INDUCED BY SOLUTE SEGREGATION. Nolfi, F.V. Jr. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Appl. Phys. 47: No. 1, 24-36 (Jan 1976).

Expressions are derived for the elastic interaction energy between void-solute shell composites. These composites consist of spherical void cores surrounded by spherically symmetric solute shells containing a uniform concentration of irradiation segregated solute. The solutes are assumed "misfitting" and as such represent sources of internal stress. The elastic interaction energy between composites arises because of the so-called inhomogeneity interaction and has minimum values at certain composite separations and solute shell thickness. The existence of these minima obtains largely because the misfit of the composites increases as the composite separation R increases. For a constant misfit, the interaction energy would decrease monotonically approximately as R^{-6}. The surface stress of voids is taken to be zero in the calculations so that the only source of interaction between composites is the stress induced by solute segregation. The calculations are performed for both two-composite and N-composite interactions, and we show that, primarily, only nearest-neighbor interactions are significant. The calculations are compared with experimental investigations of void ordering in an Ni ion-irradiated Nb-1Zr alloy containing 0.0038 atom fraction of oxygen as an impurity. Given experimentally determined void sizes and auxiliary data, the correct void lattice parameter is predicted when the solute shell thickness is ~30% of the composite radius. In pure Nb, it is found the O, C, or N impurities are necessary for void ordering, which supports the main thesis of the present paper, viz., solutes/impurities are a primary cause of void ordering. (auth)

20851 PROFILE STUDIES OF HYDROGEN TRAPPING IN METALS DUE TO ION DAMAGE. Picraux, S.T.; Bøttiger, J.; Rud, N. (Institute of Physics, University of Aarhus, DK-800 Aarhus C, Denmark). Appl. Phys. Lett. 28: No. 4, 179-181 (15 Feb 1976).

The retention of hydrogen isotopes in Mo at room temperature after ion implantation damage has been studied by measurements of H depth profiles and total D retained in the near-surface region. Implantations of He, O, Ne, and Bi in a fluence range 3×10^{14}–2×10^{17}/cm^2 were followed by 8-keV hydrogen bombardment to fluences of 2×10^{15}–2×10^{17}/cm^2. Large enhancements in the amount of hydrogen retained in preimplanted samples over samples without prior implantation have been observed and are interpreted in terms of damage trapping. For a given predamage ion fluence hydrogen retention increases linearly with hydrogen fluence until a saturation level is reached. Increased predamage fluence results in increased saturation level for hydrogen trapping, with average concentrations as high as ~10 at.% achieved. An ion-mass dependence indicates that the lighter ions, which create fewer primary displacements, are more effective in hydrogen trapping, suggesting a dependence on the damage density in the ion cascades. (auth)

20852 EFFECTS OF NEUTRON IRRADIATION ON THE CRITICAL CURRENT OF Nb_3Sn AT HIGH FIELD. Snead, C. L. Jr. (Brookhaven National Lab., Upton, NY); Parkin, D. M. Trans. Am. Nucl. Soc.; 22: 157-158(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20853 HELIUM CHARGING OF METALS BY TRITIUM DECAY. Remark, J. F. (Battelle Northwest Labs., Richland, WA); Johnson, A. B. Jr.; Farrar, H. IV; Atteridge, D. G. Trans. Am. Nucl. Soc.; 22: 175-176(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20854 EFFECT OF HELIUM ON VOID SWELLING IN VANADIUM. Brimhall, J. L.; Simonen, E. P. (Battelle Northwest Labs., Richland, WA). Trans. Am. Nucl. Soc.; 22: 176(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20855 SWELLING AND MICROSTRUCTURAL CHANGES IN IRRADIATED VANADIUM ALLOYS. Bentley, J.; Wiffen, F. W. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 176-177(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20856 TEMPERATURE AND FLUENCE LIMITATIONS FOR A TYPE 316 STAINLESS-STEEL CTR FIRST WALL. Bloom, E. E.; Wiffen, F. W.; Maziasz, P. J. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 178-179(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20857 COMPRESSIVE CREEP OF NEUTRON-IRRADIATED MOLYBDENUM. Zielinski, R. E. (Monsanto Research Corp., Miamisburg, OH); Sikka, V. K. Trans. Am. Nucl. Soc.; 22: 200(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20858 INFLUENCE OF IRRADIATION CONDITIONS AND IMPURITIES ON NEUTRON DAMAGE IN MOLYBDENUM. Sikka, V. K. (Oak Ridge National Lab., TN); Moteff, J. Trans. Am. Nucl. Soc.; 22: 214-216(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20859 EFFECT OF NEUTRON IRRADIATION ON STATIC STRAIN AGING IN MILD STEEL. Murty, K. L. (Babcock and Wilcox Co., Lynchburg, VA); Hall, E. O. Trans. Am. Nucl. Soc.; 22: 216-217(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20860 SIGNIFICANCE OF INDIRECT DISPLACEMENTS IN THE DEVELOPMENT OF DISLOCATION LOOPS IN ELECTRON-IRRADIATED ALUMINUM. Bhatnagar, S. K. (United Engineers and Constructors, Inc., Philadelphia); Jesser, W. A. Trans. Am. Nucl. Soc.; 22: 217-218(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20861 ELECTRON IRRADIATION OF ALUMINUM IN A HIGH-VOLTAGE ELECTRON MICROSCOPE. Yang, W. J.; Dodd, R. A.; Kulcinski, G. L. (Univ. of Wisconsin, Madison). Trans. Am. Nucl. Soc.; 22: 218(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20862 FATIGUE CRACK GROWTH RESISTANCE OF SEVERAL NEUTRON IRRADIATED PRESSURE VESSEL STEELS AND WELDS. Shahinian, P.; Watson, H. E.; Hawthorne, J. R. (Naval Research Lab., Washington, DC). J. Eng. Mater. Technol.; 96: No. 4, 242-248(Oct 1974).

Pre and postirradiation fatigue crack growth rates in A302-B, A533-B, and A543 steel plate and in two A543 welds (submerged arc and electroslag) were determined at 550°F in air. The fracture mechanics approach was used to analyze the experimental data. Neutron irradiation at 585°F to 2.5 x 10^{19} n/cm^2, greater than 1 MeV produced no significant effect on resistance to crack growth in A302-B steel and caused only a slight decrease in crack growth resistance of A533-B and A543 steels. Also, the resistance to crack growth of the submerged arc weld was unaffected by the irradiation, but that of the electroslag weld was substantially improved. The crack growth rate versus stress intensity factor range curve for the A302-B steel represents an upper bound for the pre and postirradiation data for the steels and welds of this study. (auth)

20863 DIFFUSION OF INERT GASES IN SILVER. II. Recrystallized and Single Crystalline Silver. Matzke, H.; Rickers, G.; Sorensens, G. (Univ. of Aarhus, Denmark). Acta Metall.; 23: No. 12, 1529-1539(Dec 1975).

The diffusion of Kr and Xe in pre-annealed, recrystallized silver foils and in silver single crystals was studied employing the technique of ion bombardment to label the solid with gas. Gas diffusion was followed by both release measurements and measurements of the concentration profiles of the gas remaining in the solid following annealing. At low bombardment doses, most of the gas release was compatible with a volume diffusion process with an activation enthalpy, DELTA H, of 1.75 eV, a value which is slightly smaller than that of silver self-diffusion, but somewhat bigger than predicted by theory. A small fraction of the gas seemed to be trapped even at low gas concentrations (3 x 10^{-5} at. percent). The DELTA H was independent of bombardment energy (5 to 450 keV) and hence of changes in the diffusion distance by about a factor of 10^2, as would be expected for a volume diffusion process. At higher doses, release was retarded and the apparent DELTA H-values surpassed that of silver self-diffusion. This was explained as being due to interactions of gas atoms with radiation damage. The results are compared with those obtained on cold-worked silver and are used to explain the unusually large scatter in the published literature. (auth)

20864 FAST- AND THERMAL-NEUTRON IRRADIATION AND ANNEALING OF Cu, Ni, Fe, Ti, AND Pd. Horak, J. A.; Blewitt, T. H. (Argonne National Lab., IL). Nucl. Technol.; 27: No. 3, 416-438(Nov 1975).

Concentrations of lattice point defects produced by thermal-neutron and fast-neutron irradiation of copper, nickel, iron, titanium, and palladium at 4.5°K were measured resistometrically, and the values are compared with the theoretically predicted values. For thermal-neutron irradiation the ratio of the predicted to measured concentration of defects ranged from a minimum of 1.0 for titanium to a maximum of 4.5 for palladium; for fast-neutron irradiation this ratio ranged from 2.3 for titanium to 6.5 for copper. On postirradiation isochronal annealing no stage II or V are present in copper after thermal-neutron irradiation, but both these stages are present after fast-neutron irradiation. Both nickel and titanium exhibit more than 100 percent recovery, super-recovery, after thermal-neutron irradiation. The super-recovery is attributed to the irradiation-induced supersaturation of vacancies that provide the enhanced diffusion required for the precipitation of impurity atoms from the lattice. Little or no enhanced diffusion is observed after fast-neutron irradiation of nickel and titanium. (auth)

20865 FAST NEUTRON IRRADIATION EFFECTS ON DRIFT MOBILITY OF HOLES IN N-TYPE GERMANIUM AND SILICON. El-Difrawi, A.A.H. Lexington, KY; Univ. of Kentucky (1974). 162p. University Microfilms Order No. 75-18,477.

Thesis (Ph. D.).

The effects of fast neutron irradiation on the electronic transport properties of semiconductors, in particular the effects as measured by the Haynes-Shockley method, on the hole mobility in n-type germanium and n-type silicon were studied. Experimental studies on the effect of neutron induced disordered regions on the hole bulk mobility are limited and contradictory. An explanation for the contradictions was found and the study showed that the bulk mobility decreases with irradiation. In addition, an explanation was found for a mobility field dependence, half-width dependence on carrier injection concentration, discontinuity in the slope of the mobility vs temperature relation, and a variation of collected pulse half-width with the transit-distance. For silicon the room temperature annealing added to difficulty in obtaining as detailed a study as that obtained on germanium. Nevertheless a preliminary study showed that hole mobility initially increases with irradiation. Apparently there is a surface contribution to the hole mobility in silicon which increases with radiation, as can occur in the case of germanium. (Diss. Abstr. Int., B)

20866 SELF-IRRADIATION DAMAGE IN ACTINIDE METALS AND ALLOYS. Martimer, M. J.; Marples, J. A. C.; Lee, J. A. (UKAEA Research Group, Harwell). Int. Metall. Rev.; 20: 109-119(Sep 1975).

The effects of self-irradiation damage on the physical properties of the α-emitting actinide metals Th, Pa, U, Np, and Pu and some of their alloys are reviewed; compounds are not considered. The damage to the lattice caused by the α-particles and recoiling nuclei anneals out below room temperature so that the experiments have to be carried out at cryogenic temperatures, mainly in liquid helium. The properties that have been studied include resistivity, length, lattice parameters, thermal conductivity, and specific heat. Most work has been done on the resistivities. These increase with time, showing an exponential approach to saturation after some thousands of hours. In addition to the main exponential law, smaller exponential terms can be separated in some cases, indicating that more than one damage mechanism occurs. The lengths and lattice parameters also saturate exponentially. For most materials these increase but the metastable phases β- and α-plutonium contract with time. Because the α-particle and, particularly, the recoiling nucleus have only short ranges in these metals, large numbers of atoms are displaced from the lattice in a small volume. The defects are thus not independent of each other, and this, combined with the complex electronic and crystal structures of the actinides, makes calculations on the detailed structure of the defects very difficult. The subject has therefore been approached from a phenomenological standpoint. (auth)

Other Materials

Refer also to abstracts 20198, 20360, 20361, 20367, 20368, 20628, 20650, 20708, 20724, 20750, 20751, 20791, 20796, 20965, 21542, 21543, 21545, 21832, 22042, and 22305.

20867 (CNLM-1626) FABRICATION AND INSPECTION REPORT FOR CERAMIC TYPE FUEL ELEMENT. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 7 Jan 1959. 55p. Dep. NTIS $4.50.

Declassified 9 Oct 1971.

Data and information are presented on fabrication and inspection of ceramic BeO-UO_2 fuel elements. The data and information are presented on sheets listing fabrication history and inspection history. (JRD)

20868 (LBL-2728) ELECTRON MICROSCOPY STUDIES OF ION IMPLANTED SILICON. Seshan, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-eng-48. 108p. Dep. NTIS $5.50.

Thesis.

The nature of defects resulting from the implantation of phosphorous ions into doped silicon and a model of how they form are reported. This involved an electron microscope study of the crystallographic defects (in the 300A size range in concentration of 10^{15}/cm^3) that form upon annealing. Images formed by these crystallographic defects are complex and that nonconventional imaging techniques are required for their character-

ization. The images of these small defects (about 300A) are sensitive to various parameters, such as foil thickness, their position in the foil, and diffracting conditions. The defects were found to be mostly interstitial hexagonal Frank loops lying on the four [111] planes and a few perfect interstitial loops; these loops occurred in concentrations of about $10^{16}/cm^3$. In addition, "rod like" linear defects that are shown to be interstitial are also found in concentrations of $10^{13}/cm^3$. It was found that the linear defects require boron for their formation. A model is proposed to account for the interstitial defects. The number of point defects that make up the defects is of the same order as the number of implanted ions. The model predicts that only interstitial loops ought to be observed in agreement with several recent investigations. Dislocation models of the loops are examined and it is shown that phosphorous ions could segregate to the Frank loops, changing their displacement vectors to a/x[111]. (x greater than 3) thus explaining the contrast effects observed. It would also explain the relative electrical inactivity of P^+ ion implants. (DLC)

20869 (NUREG-75/107) PHOTOELASTIC STUDY OF DYNAMIC FRACTURE BEHAVIOR OF HOMALITE 100. Irwin, G. R.; Dally, J. W.; Kobayashi, T.; Etheridge, J. M. (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). Sep 1975. Contract AT(49-24)-0174. 129p. NTIS $5.75.

This report describes an experimental investigation of the dynamic behavior of cracks propagation in Homalite 100, a brittle thermosetting polymeric material. Dynamic photoelectric isochromatic fringe patterns associated with cracks propagating in center-pin-loaded, eccentric-pin-loaded and crack-line-loaded SEN specimens were recorded with a high speed multiple spark camera. Data was obtained from 11 tests over a range of crack velocities from arrest to the terminal velocity of 15,000 in/sec. The size and shape of the isochromatic loops were used to determine the instantaneous values of K by matching analytical and experimental results. The analytical results employed a Westergaard stress function of the form Z(z) equals K/root 2 pi z[1 + (z/a)] and a superimposed sigma/sub ox/ equals alpha K/root 2 pi a. Results were obtained by computer program (FRACTURE) for different values of alpha, beta, K and a to give 8925 analytical fringe loops. Another computer program (SEARCH I) was used to find the best fit to each experimentally determined loop based on a comparison function. After a close fit was obtained, the instantaneous K was determined. Results show that K/sub a/ and K/sub IC/ are nearly the same and that a increases abruptly from 0 to about 10,000 in/sec for modest increases in K above 400 psi root in. Further increases in crack velocity require significant increases in K until terminal velocity is reached at K equals 2000 psi root in. At this value of K the crack attempts to branch and produces a large number of small branches.

20870 (RL-75-136) POST IRRADIATION MECHANICAL PROPERTIES OF RADIATION RESISTANT CAST EPOXY RESIN SYSTEMS. Morgan, J. T.; Stapleton, G. B. (Science Research Council, Chilton (UK). Rutherford Lab.). Jul 1975. 40p. Dep. NTIS (US Sales Only) $4.00.

The changes in mechanical properties, with irradiation, of various cast epoxy resin formulations are tabulated for integrated doses of up to 10^{10} rad. The formulations chosen are representative of the more radiation resistant types. Furthermore consideration has been given to systems that are capable of curing at ambient temperatures. Traditional systems have been included in this experiment for comparison. (auth)

20871 COMPARISON OF BORON AND NEON DAMAGE EFFECTS IN BORON ION-IMPLANTED RESISTORS. MacIver, B. A. (General Motors Research Labs., Warren, MI). Electron. Lett.; 11: No. 20, 484-485(2 Oct 1975).

Boron and neon damage implants were used in fabricating integrated-circuit resistors in silicon. Resistor properties were studied as functions of damaging ion species and dose. Sheet resistances in the 10,000 Ω/□ range were obtained with low temperature and voltage sensitivities and dc isolation. (auth)

20872 NEW TECHNIQUE FOR THE METALLIZATION OF PLASTICS. Lupinski, J. H.; Joynson, C. W. Galvano-Organo; 43: No. 447, 787-790(Sep 1974). (In French)

A porous elastomer coating containing CdO and ZnO particles can be applied to virtually any plastic substrate. The oxides are then reduced to metallic particles by electrochemical reduction in dilute KOH solution. The resulting conducting film is capable of being plated with Cu from a chemical or electrochemical bath. Results of adhesion, leveling and thermal-shock tests on the coatings are given. (Metals Abstr.)

20873 CHROMATE CONVERSION COATINGS FOR ZINC AND CADMIUM. David, G.; Darracq, G. Galvano-Organo; 43: No. 447, 767-772(Sep 1974). (In French)

The characteristics of chromate films on Zn and Cd, the bath parameters, and the testing methods are described. Choice of a chromating medium, operating conditions and the classes of finish obtained are considered. (Metals Abstr.)

20874 CRYSTAL STRUCTURE AND LUBRICATING CAPACITY OF MOLYBDENUM DISULPHIDE DIFFUSION COATINGS ON MOLYBDENUM. Dukhovskoy, E. A.; Lobashev, B. P.; Makarov, Yu. V.; Sarpov, N. I.; Silin, A. A. Fiz.-Khim. Mekh. Mater.; 11: No. 2, 71-74(1975). (In Russian)

The crystal structure and lubricating efficiency of MoS_2 coatings on Mo surfaces were studied in relation to the mode of deposition and the period of contact. The crystal structure was verified by X-ray diffraction and the effectiveness of lubrication by standard friction measurements. The wear fragments were analyzed according to particle size. The results confirmed that the thermal stability of the diffusion coating was determined ultimately by changes due to interaction with the base. After annealing at 600 and 800°C these changes expressed themselves in the form of a two-fold friction mechanism; after annealing at 1000°C the structure changed completely and the lubricant detached itself from the metal surface. (Metals Abstr.)

20875 TWO-DIMENSIONAL THERMOMECHANICAL RESPONSE OF MATERIALS, LAMINATES AND STRUCTURES TO PULSED ELECTRON BEAMS. Schallhorn, D. R.; Oswald, R. B. Jr.; Scharf, W. D.; Skillington, G. L.; Oldham, T. R.; Baba, A. J. IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2576-2581(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The thermomechanical response of five structures of varying complexity to pulsed electron beams is measured by use of a laser interferometer arrangement. The five structures are (1) a thin (uniformly irradiated) aluminum disk, (2) an aluminum disk thicker than the range of the incident electrons, (3) a two layer (kovar-silicon) laminate, (4) a three layer (glass-kovar-silicon) laminate, and (5) a simple inlaid structure consisting of a kovar cup filled with glass and topped with a silicon chip. The experimental results for these structures are compared with calculations performed using the computer code TWODY3. The results obtained so far show that a two-dimensional wave propagation code is useful for predicting the response of structures possessing cylindrical symmetry. However, the results also suggest that some improvement should be possible. The use of a one-dimensional electron transport code is probably sufficient for some structures but not for those with interfaces in the radial direction. For that case, a two-dimensional code is probably necessary. (auth)

20876 STUDY OF ATOMIC DISORDER PRODUCED BY FAST NEUTRONS IN SILICON USING INFRARED SPECTROSCOPY. Rolle, M.E.; Corelli, J.C. (Department of Nuclear Engineering, Rensselaer Polytechnic Institute, Troy, New York 12181). J. Appl. Phys. 47: No. 1, 37-42 (Jan 1976).

A study has been made of the absorption bands of silicon, irradiated with high doses of fast neutrons ($E > 1$ MeV), by infrared spectroscopy in the region between 200 and 4000 cm^{-1} (50–2.5 μ). The relationship between several effects [band tailing (0.2–0.5. eV), divacancy-associated band (3.45 μm), higher-order bands (700–1400 cm^{-1}), and single-phonon bands (observed at 488, 410, and 332 cm^{-1})] and different irradiation doses up to 10^{19} fast neutrons/cm^2 has been investigated. From the results of the absorption due to band tailing it can be assumed that the crystal is not amorphous. However, the observed vanishing of the higher-order bands at the highest doses indicates an important change in the damaged lattice. The annealing behavior up to 600 °C, at the measuring temperatures of 78 and 300 °K, showed a slower annealing out of the single-phonon bands for the high dose. From the stressing experiments, performed for single-phonon bands, a constant dichroic ratio of 1.12 was measured. From this an estimation of the radiation-induced strain within the lattice was made and found to be $\simeq 2 \times 10^{-2}$. A new electronic band was found after a long-term annealing at the wave number 312 cm^{-1}. (auth)

20877 ANOMALOUS MIGRATION OF ION-IMPLANTED Al IN Si. Dietrich, H.B.; Weisenberger, W.H.; Comas, J. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 28: No. 4, 182-184 (15 Feb 1976).

Depth profiles for 60-keV Al^+ implanted in Si have been measured by SIMS analysis as a function of implant fluence and anneal temperature. A pronounced structure has been observed in the annealed profiles for fluences $\geq 10^{15}$ cm^{-2}. Comparison of the Al profiles with those of implanted B and Ga established that the structure is species dependent. The results of measurements designed to isolate damage effects indicate that the observed structure is induced by the reordering of the amorphous layer. (auth)

20878 ENHANCEMENT OF THE DONOR ACTIVITY OF IMPLANTED SELENIUM IN GaAs BY GALLIUM

IMPLANTATION. Woodcock, J.M. (Mullard Research Laboratories, Redhill, Surrey, England). Appl. Phys. Lett. 28: No. 4, 226-227 (15 Feb 1976).

n-type doping levels in GaAs up to 5×10^{18} cm^{-3} have been obtained by the ion implantation of 400-keV selenium ions at 200°C followed by 360-keV gallium ions at 200°C. This is an order of magnitude above the maximum obtained from the implantation of selenium alone. (auth)

20879 INFRARED REFLECTION AND RAMAN SCATTERING OF ION-IMPLANTED NITROGEN IN GALLIUM PHOSPHIDE. Kachare, A.H.; Cherlow, J.M.; Yang, T.T.; Spitzer, W.G. (Departments of Electrical Engineering and Physics, University of Southern California, Los Angeles, California 90007); Euler, F.K. J. Appl. Phys. 47: No. 1, 161-173 (Jan 1976).

Infrared reflection and Raman scattering measurements were performed on a set of GaP samples implanted at room temperature with $^{14}N^+$ and $^{15}N^+$ ions with an energy of 3 MeV and fluences in the range of 5×10^{13}–2×10^{17} ions/cm^2. The reflection data for all but the most heavily implanted samples were fitted with a classical dispersion layer model. Some of the parameters used in this model were obtained from the Raman data. An increased in the damping constant γ is the largest implantation-induced change in the dispersion parameters. Annealing studies were performed on several samples implanted with 2×10^{17} ions/cm^2. Raman and x-ray measurements indicated that samples annealed at 773°K recrystallized in a polycrystalline fashion but those annealed at 573°K became single crystals. After both types of annealing procedure, structure resulting from the nitrogen localized vibrational mode was seen in the reflection spectra. This mode exhibited the expected isotope shift, appearing at ~495 cm^{-1} for samples implanted with $^{14}N^+$ and ~480 cm^{-1} for samples implanted with $^{15}N^+$. That the mode was observable only after annealing indicated that there was some reduction of the short-range order in the unannealed samples. The results are discussed in terms of prevalent models for lattice disorder introduced by ion implantation. (auth)

20880 COUPLED FAST-SLOW DIFFUSION MODEL FOR METALLIC FISSION PRODUCTS IN GRAPHITE. Zumwalt, L. R.; Phelps, J. S. Jr. (North Carolina State Univ., Raleigh). Trans. Am. Nucl. Soc.; 22: 212-213(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20881 PROTECTIVE COATINGS IN FIBER-REINFORCED MATERIALS. Karpinos, D. M. Zashch. Pokrytiya Met.; No. 8, 146-150(1974). (In Russian)

The possibility of using oxide coatings obtained in various ways as diffusion barriers in composite materials such as soft Cu matrices reinforced with W wires is discussed. These coatings, produced by vacuum metallization and thermal oxidation, hf sputtering from dielectric targets, diffusion coating in a powder mixture with subsequent thermal, oxidation, or by ceramic methods based on colloidal suspensions, prevent undesirable diffusion between metallic elements of the composite and hence eliminate the formation of brittle intermetallic compounds. The best material is probably Al_2O_3. (Metals Abstr.)

20882 STRENGTH AND FRACTURE IN GLASS MATRIX COMPOSITES. Biswas, D. R.; Fulrath, R. M. (Univ. of California, Berkeley). J. Am. Ceram. Soc.; 58: No. 11-12, 526-527(1975).

The uniaxial bend strength and fracture initiation energy of glass matrix composites containing nonspherical Al_2O_3 and spherical W particles were measured. Results show that, although the strength is increased by incorporation of 47.4 vol percent W, the fracture initiation energy was nearly the same as that for glass. (JRD)

20883 DIAGRAM OF THE DIMENSIONAL CHANGES IN GRAPHITE DUE TO IRRADIATION. Virgil'ev, Yu. S.; Kalyagina, I. P. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 2, 180-183 (Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 2, 218-222(Feb 1975).

Diagrams of radioinduced dimensional changes in several grades of graphite are presented. The diagrams relate the changes in volume to the temperature and neutron dose. It is noted that volume changes in graphite are due to radioinduced vacancy and interstitial transformation. (JRD)

20884 REACTION OF NUCLEAR GRAPHITES WITH HYDROGEN. Imia, H.; Nomura, S.; Sasaki, Y. (Japan Atomic Energy Research Establishment, Tokai). Carbon; 13: No. 4, 333-336 (Aug 1975).

The corrosion reactions of various nuclear graphites with hydrogen were studied in the temperature range 970 to 1090°C at hydrogen partial pressures between 7 and 48 torr in helium stream of total pressure of 1 atm. Methane was the only gaseous product found in this reaction. The rates of corrosion reaction were found to be $10^{-1} \sim 10^{-2}$ $\mu g/cm^2$ h on the basis of methane yield at 28 torr hydrogen pressure at 1025°C. The influence of the hydrogen partial pressure on the methane production rate is expressed as: $R = K(P_{H_2})^{\frac{1}{2}}$. The apparent activation energy for the reaction was found to be 22 kcal/mol, independent of the impurity content of the graphite. No clear correlations were found between the production rate of methane and the total ash content in the graphite, its degree of crystallinity (determined by x-ray diffraction), and its degree of graphitization (inferred from butanol immersion density). (auth)

20885 DEFECT MOLECULE CALCULATION FOR THE VACANCY IN GRAPHITE. Nicholson, A. P. P.; Bacon, D. J. (Liverpool Univ.). Carbon; 13: No. 4, 275-282(Aug 1975).

The defect-molecule calculations of Coulson et al of the electronic structure of a vacancy in graphite have been improved and extended to allow for symmetric relaxation. Various problems encountered previously have been shown to be due to the use of the Goeppert-Mayer and Sklar approximation. The rebonding forces on the nearest-neighbor atoms to the vacancy have been calculated, and a perfect-lattice model was used to describe lattice relaxation effects; the difficulties experienced in work on diamond and silicon using an imperfect-lattice model were avoided. For the neutral vacancy, the stabilization energy, E_v, was found to be 1.44 eV, and the (symmetric) relaxation energy, E_g, to be 3.32 eV. The neutral vacancy formation energy has been re-calculated, and using the above values for E_v and E_g, a value of 8.75 was obtained. This is somewhat higher than experimental estimates, but the difference may be explained by a high value for the formation entropy. (auth)

20886 DETERMINATION OF THE THERMAL SHOCK RESISTANCE OF GRAPHITE BY ARC DISCHARGE HEATING. Sato, S.; Sato, K.; Imamura, Y. (Ibaraki Univ., Hitachi, Japan). Carbon; 13: No. 4, 309-316(Aug 1975).

A technique is presented to determine the thermal shock resistance of graphite by a basic analysis of non-steady thermal stress in a circular disk heated by an arc discharge at its central part. The thermal shock resistance is defined as $\Delta = \sigma_\theta\, k/E$, ($\sigma_\theta$, circumferential tensile thermal stress; k, thermal conductivity; E, Young's modulus; α, thermal expansion coefficient) and is determined en bloc only measuring the electric power of the arc discharge using the specific non-dimensional thermal stress S* which is calculated theoretically as the maximum saturation stress in the non-dimensional diffusion time $\tau > 1/4$. This technique can also be used to measure simultaneously the thermal diffusivity $k = k/cp$ (c, specific heat; p, density) using the specific non-dimensional diffusion time τ^* calculated theoretically as the heat reaching time from the center to the periphery of the disk after the arc discharge is started. The experimental studies for several kinds of graphite were carried out and the results are compared with the values of $\sigma_\theta\, k/E$ and k/cp estimated indirectly from the individual mechanical and physical properties. (auth)

20887 EFFECTS OF PRESSURE ON MAGNETIC PROPERTIES OF F-CENTERS IN RUBIDIUM HALIDES. Mamola, K.; Wu, R. (Dartmouth Coll., Hanover). J. Phys. Chem. Solids; 36: No. 12, 1323-1328(Dec 1975).

Room temperature magnetic resonance measurements have been made on additively colored RbCl and RbBr and on x-irradiated RbH at pressures up to 8 kbar. In RbCl and RbH pressure shifts of the F-center isotropic coupling constant a_1 were obtained from changes in the resolved EPR hyperfine structure. Pressure shifts of first and second shell hyperfine coupling constants of F-centers in RbBr were found from high pressure ENDOR spectra. Effects of the pressure induced polymorphic phase transformations in RbCl and RbBr are discussed. No evidence was found for a structure transformation in RbH. Room pressure ENDOR measurements on additively colored RbI were made at 77°K. The first and second shell hyperfine coupling constants are reported. All results accord well with the behavior of F-centers in other alkali halides. (auth)

20888 EPR STUDIES OF Li-DOPED N-TYPE Si BEFORE AND AFTER ELECTRON IRRADIATION. Jayapandian, D. P. Columbus; Ohio State Univ. (1975). 120p. University Microfilms Order No. 75-26,600.

Thesis (Ph. D.).

EPR spectra were studied from RT to 4.2°K. Resistivities (due to background P doping) ranged from 0.1 to 10 OMEGA cm and the lithium concentration from zero to 10^{17} atoms/cm^3. EPR spectra were recorded before and after electron irradiation (10^{18}e/cm^2) and after annealing. The electron magnetization increased with decreasing temperature down to below 20°K, and then it started to decrease, showing non-Curie behavior. This was explained by double donor interactions. The correlation time of an electron in a donor site increases at lower temperatures, resulting in considerable overlapping of the electron wave functions and strong exchange interaction, giving rise to

double donor centers. Below 20°K, some centers couple, resulting in diamagnetism. Hyperfine lines due to P nuclei appeared between 40 and 30°K, and their behavior was explained on the basis of donor electron excitation from ground state to first excited state and back, and its exchange scattering from one donor site to another via the conduction band. Rf magnetization was studied as a function of temperature, before and after irradiation and after annealing for different Li contents. The high-resistivity (10-17) sample showed an order of magnitude increase in the magnetization after irradiation, suggesting that the Li–O pair readily forms complexes with the damage centers. After 24 h at RT, there was a substantial decrease in the magnetization showing annealing of the damage centers by lithium, that are not visible by EPR. This annealing effect decreased for samples containing lower Li contents. No quadruplet splitting due to ^{7}Li hyperfine interaction was observed. (DLC)

20889 THERMAL CONDUCTIVITY OF GAMMA-IRRADIATED LiF AT LOW TEMPERATURES. Guckelsberger, K. (CEN, Grenoble, France); Neumaier, K. J. Phys. Chem. Solids; 36: No. 12, 1353-1363(Dec 1975).

The thermal conductivity of LiF single crystals which were γ-irradiated using a ^{60}Co-source at room temperature at doses ranging from $8.5\ 10^{5}$ to $3.6\ 10^{8}$ rad was measured in the temperature range from 60 mK to 100°K. The most heavily irradiated specimen was also measured after annealing treatments at temperatures between 260 and 400°C. From a numerical analysis of the thermal conductivity data the following interpretation of the thermal resistivity due to the radiation damage was derived. The defects created are threefold: (a) F-centers which act as point defects, (b) small aggregates of point defects with a diameter of about 10 Å which are less numerous than the F-centers (c) large scale aggregates containing several thousands of lattice sites which appear at irradiation doses $\gtrsim 10^{7}$ rad. Each of these defects acts on the thermal conductivity in a different temperature range and are identified as interstitial clusters through their characteristic behavior during irradiation and subsequent annealing. (auth)

20890 MAGNETIC FIELD DEPENDENCE OF THE SPECIFIC HEAT PEAK AT 0.6 TO 0.7°K IN SOFT CARBONS. Vagh, A. S.; Mrozowski, S. (State Univ. of New York, Buffalo). Carbon; 13: No. 4, 301-305(Aug 1975).

The magnetic field dependence of the specific heat peak was investigated for polycrystalline nuclear grade graphite neutron irradiated for 50 h and for a soft carbon heat-treated to HTT 1250°C. It was found that the relatively broader peak for irradiated graphite is located at 0.72°K and the sharper one for the soft carbon at 0.635°K. In both cases the dependence on the magnetic field is similar, the specific heat increases with the magnetic field from 0 to 20 kG in the whole range of temperature investigated (0.4 to 4.5°K), the increase on the high temperature side of the peak being greater than on the low temperature side. The peak's maximum shifts slightly to higher temperature with increase of the field (by 10% at 20 kG). The increase in the total specific heat at the peak's maximum is at 20 kG around 80% for the irradiated graphite and only 50% for the 1250°C carbon. It is shown that the peak is due to a cooperative antiferromagnetic interaction between localized electronic spins distributed at random throughout the material. The reasons for various complications in the overall effect are discussed. (auth)

20891 ESR STUDY OF ELECTRON AND HOLE TRAPPING IN GAMMA-IRRADIATED PYREX. Brown, G. (Royal Military Coll., Shrivenham, Eng.). J. Mater. Sci.; 10: No. 11, 1841-1848 (Nov 1975).

Electron and hole resonances, produced by γ-irradiation of Pyrex, are investigated by ESR at X-band. It is proposed that the electron traps which generate the narrow g = 2.0008 resonance arise, not from the bulk borosilicate structure, but from a submicroscopic silica glass structure. Growth curves of the trapped electron and hole populations show a two-stage behavior with increasing dose. In order to explain the growth characteristics in the low-dose region, a nonparamagnetic trapped-electron population is postulated. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Refer also to abstract 22053.

20892 (ARH-2075) HANFORD RADIOCHEMICAL SITE DECOMMISSIONING DEMONSTRATION PROGRAM. Nelson, D. C. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 9 Aug 1971. Contract E(45-1)-2130. 67p. Dep. NTIS $4.50.

A program is proposed for the innovation, development, and demonstration of technologies necessary to decommission the Hanford radiochemical plant area to the extent that the sites can have unrestricted public access. The five tasks selected for development and demonstration of restoration techniques were restoration of a burial ground, decommissioning of a separations plant, restoration of a separations plant waste interim storage tank farm, restoration of a liquid disposal area, and disposal of large contaminated equipment. Process development requirements are tabulated and discussed. A proposed schedule and estimated costs are given. (JSR)

20893 SIMPLIFIED METHOD FOR CALCULATING RADIOLOGICAL DOSE COMMITMENT FROM NUCLEAR FACILITY OPERATION. Colick, J.; Woodsum, H. (Westinghouse Environmental Systems, Pittsburgh). Trans. Am. Nucl. Soc.; 22: 102-103(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20894 ASSESSMENT OF RELATIVE NUCLIDE HAZARD. Smith, C. F. (Univ. of California, Los Angeles); Kastenberg, W. E.; Burnett, T. W. T. Trans. Am. Nucl. Soc.; 22: 103-104 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20895 LOW-LEVEL SOLID RADIOACTIVE WASTE IN THE NUCLEAR FUEL CYCLE. Mann, B. J. (Environmental Protection Agency, Las Vegas, NV); Goldberg, S. M.; Hendricks, W. D. Trans. Am. Nucl. Soc.; 22: 347(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20896 COSTS FOR PARTITIONING STRATEGIES INVOLVED IN HIGH-LEVEL NUCLEAR WASTE MANAGEMENT. Davidson, J. W.; Draper, E. L. Jr. (Univ. of Texas, Austin). Trans. Am. Nucl. Soc.; 22: 348-350(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20897 WASTE MANAGEMENT IN NUCLEAR POWER PRODUCTION. Buckham, J. A.; Slansky, C. M. (Allied Chemical Corp., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 835-836 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Accountability and Safeguards

Refer also to abstracts 19660, 19664, 19665, 20298, and 20300.

20898 (SAND-75-0595) GRAPH THEORETIC MODELS OF THEFT PROBLEMS. I. The Basic Theft Model. Hulme, B. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1975. Contract AT(29-1)-789. 28p. Dep. NTIS $5.00.

This report shows how weighted graphs may be used to study the vulnerability of a fixed-site security system to theft. A general way of constructing graph theoretic models is presented together with variations in the types of weight functions which will produce different specific models designed to accommodate various physical situations. One specific model is studied in detail, the basic theft model, in which the weights are constants independent of the direction of travel. This model admits solution by a Dijkstra-type algorithm, and hence the run time is roughly proportional to the square of the number of nodes in the graph. (auth)

20899 QUANTITATIVE EVALUATION OF A REAL-TIME MATERIAL CONTROL SYSTEM FOR A MIXED-OXIDE FUEL PLANT. Harris, L. Jr. (Science Application, Inc., Huntsville, AL); Kull, L. A.; Bain, E. E.; Gozani, T.; Simmons, G. L.; Olliver, R. T.; Pomernacki, C. L. Trans. Am. Nucl. Soc.; 22: 142-143 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20900 NUCLEAR ASSAY TECHNIQUES FOR A MIXED OXIDE FUEL PLANT. Gozani, T.; Harris, L. Jr.; Kull, L. A. (Science Applications, Inc., Huntsville, AL). Trans. Am. Nucl. Soc.; 22: 143(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20901 LINEAR FILTERING APPLIED TO SAFEGUARDS OF NUCLEAR MATERIAL. Pike, D. H. (Univ. of Tennessee, Knoxville); Morrison, G. W.; Holland, C. W. Trans. Am. Nucl. Soc.; 22: 143-144(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20902 ADVERSARY CHARACTERIZATION FOR SECURITY SYSTEM EVALUATION. Suber, L. A. (Sandia Labs., Albuquerque, NM). Trans. Am. Nucl. Soc.; 22: 340-341(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20903 ERDA DEMONSTRATION OF SAFEGUARDS FOR FUEL CYCLE MATERIALS AND FACILITIES. Lyon, H. E.; Bartels, W. C. (Energy Research and Development Administration, Washington, DC). Trans. Am. Nucl. Soc.; 22: 341-342 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20904 SAFEGUARDS: A SYSTEMATIC ANALYSIS BY THE NRC. Smiley, S. H. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 342-343(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20905 CONTINUOUS INVENTORY IN SNM STORAGE FACILITIES. Chambers, W. H. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 343-344(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20906 USE DENIAL OF SPECIAL FISSIONABLE MATERIALS. Zehr, S. W.; Mar, R. W. (Sandia Labs., Livermore, CA). Trans. Am. Nucl. Soc.; 22: 344(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20907 NONDESTRUCTIVE ASSAY TECHNOLOGY AND IN-PLANT DYNAMIC MATERIALS CONTROL. Keepin, G. R. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 833-834(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20908 HOMEMADE NUCLEAR BOMB SYNDROME. Meyer, W.; Loyalka, S. K.; Williams, R. (Univ. of Missouri, Columbia). Trans. Am. Nucl. Soc.; 22: 834-835(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20909 OPTIMIZING THE USE OF BIAS CORRECTIONS IN MINIMIZING THE VARIANCE OF MUF. Stewart, K. B. (Pacific Northwest Labs., Richland, WA). Nucl. Mater. Manage.; 4: No. 4, 48-53(Win 1976).

From 17th annual meeting of the Institute of Nuclear Materials Management, Inc.; Seattle, WA (22 Jun 1976).

A method for apportioning the effort used in making bias corrections to measurement processes is described. The variance of the error of bias corrections to measurement processes is part of the variance of material unaccounted for (MUF). A method of minimizing this part of the MUF variance for a total cost constraint is examined. (JRD)

20910 SYSTEM OF ACCOUNTABILITY AND QUALITY FUEL ROD SCANNING IN A FUEL FABRICATION FACILITY. Stewart, J. P. (General Electric Co., Wilmington, NC). Nucl. Mater. Manage.; 4: No. 4, 42-47(Win 1976).

From 17th annual meeting of the Institute of Nuclear Materials Management, Inc.; Seattle, WA (22 Jun 1976).

Development of the ^{252}Cf fuel rod scanning system is described. The feasibility of the technique was demonstrated and a scanning system was devised, with ^{252}Cf as a source of neutrons, which fulfilled the following requirements: (a) thermal neutron flux in the vicinity of 5×10^6 n-cm^{-2}-s^{-1} with a ^{235}U; ^{239}U fission

ratio of at least 10^4; (b) minimum source-to-detector spacing required to optimize the signal, yet sufficient to give an acceptably low background count rate from the ^{252}Cf source; (c) provision for adequate shielding of personnel; and (d) multiple irradiation channels for production fuel scanning flexibility and optimum source utilization, but with spacing adequate to prevent excessive adjacent channel interaction and to accommodate a fuel rod handling system. The ^{252}Cf fuel rod scanning system is used for the routine evaluation and assay of production fuel rods as part of the quality inspection process at the Wilmington facility. Routine scanning operations, standardization, and measurement control are subject to continual evaluation and are consistent with recent Nuclear Regulatory Commission Guides and relevant ANSI Standards. (auth)

20911 ERRORS OF MEASUREMENT WITH MORE THAN TWO MEASUREMENT METHODS. Jaech, J. L. (Exxon Nuclear Co., Inc., Richland, WA). Nucl. Mater. Manage.; 4: No. 4, 38-41(Win 1976).

From 17th annual meeting of the Institute of Nuclear Materials Management, Inc.; Seattle, WA (22 Jun 1976).

Methods of obtaining estimates of the precision in safeguard applications in cases where there are more than two measurement methods are examined. Estimating equations are given and large sample test procedures are described. The methodology is applied in an example involving auditing the performance of accountability scales in which 15 items of varying weights were weighed on each of six scales. (JRD)

20912 NUCLEAR MATERIALS INFORMATION SYSTEM. Haycock, T. J. Jr. Nucl. Mater. Manage.; 4: No. 4, 31-37(Win 1976).

From 17th annual meeting of the Institute of Nuclear Materials Management, Inc.; Seattle, WA (22 Jun 1976).

The strengths and shortcomings of the Nuclear Materials Information System are examined. A description of the system is given and areas of safeguards concern such as material balance information, inventories, exception reporting, inspections, transportation, interfaces with IAEA and other systems, and physical security are reviewed along with response capabilities and areas of criticism. (JRD)

20913 NUCLEAR DIVERSION: AN INTERNATIONAL PROBLEM IN NEED OF INTERNATIONAL SOLUTION. Vaughan, J. E. (NUS Corp., Houston, TX). At. Energy Law J.; 17: No. 3, 179-231(Fall 1975).

This article discusses plutonium and uranium and their diversion from the nuclear power industry to weapon use in the "horizontal" proliferation problem. The way in which this problem has been handled, through international law channels, is examined. IAEA regulations and the India case are among the topics discussed. The future outlook, the growing world production of plutonium, and the problem of enforcement of the safeguarding of this material are discussed. IAEA statutes, international agreements, treaties, and nonproliferation treaty excerpts are included as appendices. (DLC)

20914 SAFEGUARDS AGAINST USE OF NUCLEAR MATERIAL FOR WEAPONS. Sanders, B.; Rometsch, R. (International Atomic Energy Agency, Vienna). Nucl. Eng. Int.; 20: No. 234, 682-685(Sep 1975).

The history of safeguards is traced from the first session of the United Nations Atomic Energy Commission in 1946, through the various stages of the IAEA safeguard system for nuclear materials and to the initiation of the Treaty on the Non-proliferation of Nuclear Weapons in 1968. The role of the IAEA under the treaty is discussed. The structure and content of safeguards agreements in connection with the treaty were laid down and the objective of safeguards clearly defined. The methods of verification by the IAEA of the facility operator's material accountancy through inspection and statistical analysis and evaluation of "material unaccounted for" are explained. The extent to which the IAEA may make use of the State's system of accounting and control of nuclear materials is considered. Reference is also made to the question of protection against theft and sabotage. The scope of safeguards work for the next 15 years is forecast. (UK)

20915 ADMINISTRATION OF CANADIAN SAFEGUARDS POLICY. Hamel, P. E. (Atomic Energy Control Board, Ottawa). Nucl. Eng. Int.; 20: No. 234, 685-686(Sep 1975).

Methods of controlling nuclear materials and equipment in Canada are discussed. The Regulations of the Atomic Energy Control Board relate mainly to national activities. With the expansion of international activities, Canada entered into trilateral agreements, on international safeguards, with the IAEA, and other participating governments, and also became an early signatory to the Treaty on the Non-Proliferation of Nuclear Weapons. In 1974 the Canadian Government declared measures for more stringent safeguards in respect of the sale abroad of Canadian nuclear materials, equipment, and related technology. The content and administration of this policy is considered. (UK)

20916 CASE FOR LOW CONCENTRATION PLUTONIUM RECYCLE. Puechl, K. H. Nucl. Eng. Int.; 20: No. 234, 687-692 (Sep 1975).

It is contended that there exist so many uncertainties that routine recycle of plutonium under currently accepted practices will not come about, even after reprocessing plants are operational. Too many ground rules have changed since the development of plutonium recycle philosophy. The alternative philosophy of dispersing all recovered plutonium throughout all LWR fuel at the lowest practical concentration is considered and appears to offer potential fuel cycle cost savings, major conservation of energy resources, significant reduction in radiological consequences and significant reduction in the probability of clandestine diversion of weapons grade material. (auth)

Disposal and Storage

Refer also to abstracts 19771, 19773, 19776, 19782, 20192, 20695, 20952, and 21987.

20917 (BNWL-1927) INCENTIVES FOR PARTITIONING HIGH-LEVEL WASTE. Burkholder, H. C.; Cloninger, M. O.; Baker, D. A.; Jansen, G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract AT(45-1)-1830. 260p. Dep. NTIS $5.45.

The incentives for separating and eliminating various elements (but particularly the transuranics) from radioactive waste prior to final geologic storage were investigated. Exposure pathways to man were defined, and potential radiation doses to an individual living within the region of influence of the underground storage site were calculated. The accumulated high-level waste (i.e., the fission product waste produced by reprocessing spent fuel) from the U. S. nuclear power economy through the Year 2000 was the assumed radionuclide source, and western U. S. desert subsoil was the assumed geologic medium. The results of the study showed that for reasonable storage conditions the potential incremental radiation doses would be of the same order as, or less than, doses from natural sources. It was therefore concluded that for the situations investigated the incentives for special effort to remove any elements, including the transuranics, from high-level waste are vanishingly small. The study results also showed that incentives exist for converting high-level calcine into glass. (auth)

20918 (CONF-750117-P2, pp 715-733) RADIOACTIVE WASTE MANAGEMENT AND ISLET DISPOSAL IN THE REPUBLIC OF CHINA. Wang, W. K.; Yuan, I. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The general radioactive waste management policies of Atomic Energy Council of Republic of China are summarized. For the final disposal of solid radioactive waste, abandoned mine, sea dumping, and underground storage were investigated and its was concluded that only the islet disposal is practical in this country. The conceptual study of the National Solid Radioactive Waste Storage Yard located at Lung-man area on Lan-Yu Islet is briefly described in this paper. (auth)

20919 (DPSPU-75-30-9) BURIAL OF A HIGH ACTIVITY WASTE EVAPORATOR TUBE BUNDLE. Ratchford, D. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Dec 1975. Contract AT(07-2)-1. 8p. (CONF-760202-31). Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Transport of a large and highly radioactive piece of failed separations equipment from process building to storage area was achieved with minimum personnel exposure through detailed preplanning by all groups concerned. Plans were developed for remote unloading, use of a sacrificial transport box, use of spacer railroad cars, off-shift movement, extra crane shielding, and radio communications. The entire operation was pretested by a dry run.

20920 (ORNL-TM-5209) EVALUATION OF WASTE DISPOSAL BY SHALE FRACTURING. Weeren, H. O. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 52p. Dep. NTIS $5.50.

The shale fracturing process is evaluated as a means for permanent disposal of radioactive intermediate level liquid waste generated at the Oak Ridge National Laboratory. The estimated capital operating and development costs of a proposed disposal facility are compared with equivalent estimated costs for alternative methods of waste fixation.

20921 TWO NUCLIDE MIGRATION MODELS AT THE MAXEY FLATS NUCLEAR WASTE BURIAL SITE. Gat, U. (Oak Ridge National Lab., TN); Thomas, J. D.; Clark, D. T. Trans. Am. Nucl. Soc.; 22: 101(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20922 TWELVE YEARS OF LOW-LEVEL WASTE BURIAL EXPERIENCE. Duckworth, J. P. (Nuclear Fuel Services, Inc., West Valley, NY). Trans. Am. Nucl. Soc.; 22: 122(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20923 CHEMISTRY AND PHYSICAL MECHANICS OF NUCLEAR WASTES IN ROCKS. Luth, W. C.; Anderson, R. N.; Jahns, R. H. (Stanford Univ., CA). Trans. Am. Nucl. Soc.; 22: 354-355(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20924 PROCESS FLUID REGENERATION AND WASTE DISPOSAL FOR ALCOHOL-SODIUM REMOVAL SYSTEMS. Welch, F. H.; Steele, O. P. (Atomics International, Canoga Park, CA). Trans. Am. Nucl. Soc.; 22: 600-601(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20925 TRITIUM CONTAINMENT AFTER BURIAL OF CONTAMINATED SOLID WASTE. Wheeler, M. L.; Warren, J. L. (Los Alamos Scientific Lab, NM). Trans. Am. Nucl. Soc.; 22: 741(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20926 MEASUREMENT OF TRANSURANIC SOLID WASTES AT THE 10 nCi/g ACTIVITY LEVEL. Umbarger, C. J.; Cowder, L. R. (Los Alamos Scientific Lab., NM). Nucl. Technol.; 27: No. 3, 500-510(Nov 1975).
Two nondestructive assay systems, the MEGAS and the Pancake Counter, for the measurement of transuranic contaminated solid wastes at 10-nCi/g activity levels, have been developed. These are NaI-based detection systems to be used specifically for low-density solid transuranic wastes. They are of value in effective implementation of new federal regulations pertaining to transuranic waste management in that they supplement the usual administrative decision making in waste handling. (auth)

Handling Equipment and Procedures

Refer also to abstracts 20170, 20425, 22204, 22007, 22049, and 22267.

20927 (SAND-75-8300) WELDED RUPTURE DISC ASSEMBLIES FOR USE IN TRITIUM RESEARCH LABORATORY. Faltings, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 11p. Dep. NTIS $3.50.
Welded rupture disc assemblies were investigated and developed in various ranges for probable use by experimenters in their activities in the Tritium Research Laboratory at Sandia Laboratories, Livermore. This study indicates that currently welded rupture disc assemblies with appropriate testing and installation by certified pressure installers may be used in pressure systems in the Tritium Research Laboratory and other areas at SLL. (auth)

20928 RADIAL COORDINATE PROFILOMETER AND THEORY FOR DIMENSIONING IRRADIATED FUEL ELEMENTS. Jarvis, R. G.; Stoute, R. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Am. Nucl. Soc.; 22: 218-219(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20929 218-NEUTRON-GROUP MASTER CROSS-SECTION LIBRARY FOR CRITICALITY SAFETY STUDIES. Ford, W. E. III; Westfall, R. M.; Webster, C. C. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 290-291(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20930 PROCEDURE FOR DETERMINING BROAD-GROUP ENERGY STRUCTURE FOR CRITICALITY SAFETY CALCULATIONS. Westfall, R. M.; Plaster, D. M.; Ford, W. E. III. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 291-292 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20931 EFFECT OF GADOLINIUM ON CRITICALITY OF U + Pu SOLUTIONS. Lloyd, R. C. (Battelle Northwest Labs., Richland, WA). Trans. Am. Nucl. Soc.; 22: 292(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20932 PROBABILISTIC SAFETY ANALYSIS OF FUEL CYCLE RISKS. Erdmann, R. C.; Fullwood, R. R.; Maly, J. (Science Applications, Inc., El Segundo, CA). Trans. Am. Nucl. Soc.; 22: 297(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20933 CROSS SECTIONS FOR CRITICALITY SAFETY COMPUTATIONS. Clark, H. K. (Savannah River Lab., Aiken, SC). Trans. Am. Nucl. Soc.; 22: 297-298(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20934 COMMENTS ON THE USE OF THE MONTE CARLO METHOD FOR CRITICALITY CALCULATIONS. Whitesides, G. E. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 298-299(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20935 REMARKS ON SURFACE DENSITY AND DENSITY ANALOG REPRESENTATION OF ARRAY CRITICALITY. Thomas, J. T. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 299-300(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20936 SPECIAL CRITICALITY CONSIDERATIONS FOR LOW-ENRICHMENT FUEL PROCESSING. Seale, R. L.; Verdon, C. (Univ. of Arizona, Tucson). Trans. Am. Nucl. Soc.; 22: 300-301 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20937 GAS HANDLING SYSTEM FOR STUDIES OF TRITIUM-CONTAINING MATERIALS. Carstens, D. H. W. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 738(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20938 TRITIUM HANDLING FACILITIES AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Anderson, J. L.; Damiano, F. A.; Nasise, J. E. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 738-739(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20939 STARTUP CONFIGURATION OF THE HOT FUEL EXAMINATION FACILITY/NORTH (HFEF/N). Swanson, N. J.; White, J. R.; Bacca, J. P. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 742-744(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20940 TECHNIQUES FOR REMOTE MAINTENANCE OF IN-CELL MATERIALS HANDLING SYSTEM IN THE HFEF/N MAIN CELL. Tobias, D. A.; Frickey, C. A. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 744-745(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20941 UNIQUE METHOD OF TRANSFERRING HIGHLY IRRADIATED COMPONENTS FROM AN α-γ FACILITY. Taylor, D. S.; Iverson, G. M.; White, J. R. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 745-746(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20942 HANDLING SYSTEM FOR LARGE SODIUM LOOPS AT HFEF. Hagmann, D. B. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 746(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20943 PNEUMATIC TRANSFER SYSTEM FOR INERT-ATMOSPHERE HOT CELLS. McClurkin, J. L.; Tobias, D. A.

(Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 747(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20944 REMOTE EXAMINATION, DISASSEMBLY, AND REASSEMBLY OF GRID-TYPE REACTOR SUBASSEMBLIES AT HFEF. McKenzie, D. A.; Taylor, D. S. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 750(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20945 REMOTE ASSEMBLY, EXAMINATION, AND DISASSEMBLY OF TREAT EXPERIMENTS AT HFEF. Cook, J. H.; Teraguchi, K. T.; Walker, K. L.; Kerr, J. F. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 752(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20946 HANDLING OF IRRADIATED ELEMENTS AND CAPSULES IN HFEF/N. White, J. R.; McClurkin, J. L.; Adam, M. F.; Hill, B. F. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 752-754(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20947 VISUAL EXAMINATION MACHINE FOR HFEF/N. McClellan, G. C.; Iverson, G. M. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 754(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20948 DATA ACQUISITION AND PROCESS CONTROL SYSTEM FOR HFEF. Just, F. H.; Ramsthaler, J. A.; Hayner, G. O.; Bono, R. W. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 755(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20949 SERVOARM: A WATER HYDRAULIC MASTER-SLAVE MANIPULATOR. Wilson, K. B. (Remotion Co., Coeur d'Alene, ID). Trans. Am. Nucl. Soc.; 22: 756(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20950 MONITOR: A VERSATILE REMOTE HANDLING SYSTEM. Horne, R. A.; Ekberg, E. L. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 756-758(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20951 LONG-RANGE, HIGH-SPEED REMOTE HANDLING AT THE CERN 26-GeV PROTON SYNCHROTRON. Horne, R. A.; Ellefsplass, M. (CERN, Geneva). Trans. Am. Nucl. Soc.; 22: 758(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20952 DEMOLITION AND REMOVAL OF PLUTONIUM-CONTAMINATED FACILITIES AT HANFORD. Raile, M. N. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Am. Nucl. Soc.; 22: 758-759(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20953 DISMANTLING A PLUTONIUM FABRICATION FACILITY. Koprowski, B. J. (Argonne National Lab., IL); Kelman, L. R.; Parker, S.; Schmitt, D. R.; Januska, A. G. Trans. Am. Nucl. Soc.; 22: 759(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Transportation

20954 (DPSPU-73-124-1) SAFETY ANALYSIS REPORT: PACKAGES COBALT-60 SHIPPING CASK (PACKAGING OF RADIOACTIVE AND FISSILE MATERIALS). Evans, J. E.; Langhaar, J. W. (comps.). (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jul 1973. Contract AT(07-2)-1. 211p. Dep. NTIS $7.75.
Safety Analysis Report DPSPU-73-124-1 replaces DPSPU-69-124-1 and Supplement 1 to permit shipment of 350,000 curies of ^{60}Co (maximum) in cobalt-60 shipping casks in compliance with 10 CFR Part 71, Packaging of Radioactive Materials for Transport. (auth)

20955 STATUS OF SPENT-FUEL STORAGE IN THE UNITED STATES. Chaffin, M. H.; Aucoin, P. A. (Nuclear Assurance Corp., Atlanta). Trans. Am. Nucl. Soc.; 22: 304(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20956 REGULATION OF SPENT-FUEL STORAGE IN THE U.S. Cunningham, R. E. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 304-305(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20957 POOL-TO-POOL SHIPMENTS OF SPENT-FUEL ASSEMBLIES. Teer, B. R. (Transnuclear, Inc., White Plains, NY). Trans. Am. Nucl. Soc.; 22: 305(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20958 SPENT- AND FRESH-FUEL SHIPPING CASK CONSIDERATIONS. Shappert, L. B. (Oak Ridge National Lab., TN); Unger, W. E.; Freedman, J. M. Trans. Am. Nucl. Soc.; 22: 772-773(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 21547.

20959 (JINR-D1-5969, pp 331-355) 300-GeV PROTON SYNCHROTRON PROJECT OF CERN. Ranft, J. (Karl-Marx-Univ., Leipzig). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

In February, 1970, the Cern Council authorized the construction of a 300 GeV proton synchrotron near the present CERN Laboratory. Some features of the new design of this accelerator which were worked out during the years 1969 and 1970 are summarized. (auth)

20960 (LA-UR-75-2383) STATUS OF THE CLINTON P. ANDERSON MESON PHYSICS FACILITY (LAMPF). Jain, M.; Rosen, L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 13p. (CONF-751223-1). Dep. NTIS $3.50.

From 7th international conference on few body problems in nuclear and particle physics; New Delhi, India (29 Dec 1975).

A brief history and a description of the LAMPF Linac is given, followed by a discussion of the experimental areas, some selected experimental results, and some practical applications. Differential cross section data for n-p charge exchange scattering near 640 MeV are compared with data taken on other machines, and data on pion scattering are presented. The application of negative pions to the treatment of cancer is discussed. (PMA)

20961 (LBL-4602) VERY HIGH ENERGY HEAVY-ION ACCELERATORS. Grunder, H. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 6p. (CONF-751048-7). Dep. NTIS $3.50.

From international conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

A review is given of various programs for building heavy ion accelerators. Topics discussed are (1) options of reaching very high energies with heavy ions; (2) present performance of the superHILAC and the Bevalac; (3) heavy ion sources; (4) applications of heavy ion accelerators outside of basic research; and (5) reliability and operating costs of heavy ion sources. (PMA)

20962 (ORO-4856-48) SOME HIGHLIGHTS OF THE UNIVERSITY OF MARYLAND CYCLOTRON. Pugh, H. G. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1975. 13p. Dep. NTIS $3.50.

A review is given of the beam energies, the cyclotron layout, the personnel, and use of the Maryland Cyclotron. The discussion of some of the experiments includes: (1) pion production; (2) elastic proton scattering at 100 MeV; (3) quasi-free processes; (4) gamma rays following proton bombardment; (5) highly excited nuclear states; and (6) rearrangement energy. (PMA)

20963 (TID-26942) MONTHLY REPORT OF THE FERMI NATIONAL ACCELERATOR LABORATORY. Sanford, J. R. (ed.). (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Nov 1975. 24p. Dep. NTIS $3.50.

The first neutron beam was obtained in the Cancer Therapy Facility at Fermilab, and measurements of beam characteristics, mainly the determination of dose distributions, were begun. Beam requirements for medical research, beam transport, facility funding, and facility status and long-term schedule are discussed. The general use of the Fermilab Accelerator during the month of October 1975 is summarized. (PMA)

20964 (TID-26948) METHODS FOR TRANSPORTING KAONS TO BUBBLE CHAMBERS AT FERMILAB. Albright, J. R. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). 19 Aug 1975. 19p. Dep. NTIS $3.50.

A review is given of various beam transport methods that are proposed for beams of charged and of neutral kaons to be used in bubble chamber experiments. So far, there are no plans to produce separated beams of kaons at Fermilab energies; instead emphasis was placed on the concept of enriched beams. For charged particles, there will be some contamination in the beam, but the contamination will be identified by counters and wire chambers on a track-by-track basis. The enrichment refers to the use of various strategems to improve the ratio of wanted to unwanted particles so as to avoid undue waste of film and running time. (auth)

20965 SIMPLE LINEAR ACCELERATOR FOR DOPING SEMICONDUCTORS BY ION IMPLANTATION TECHNOLOGY. Ribarov, S. R. (Inst. of Nuclear Physics, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 4, 461-464(1975).

The use of linear accelerators with mass separators for semiconductor fabrication is justified when high-purity doping is required. There are some substantial shortcomings: (1) low efficiency of doping and; (2) difficulty of operation. A design is given which avoids these shortcomings to a considerable degree. (PMA)

20966 SELF-SHIELDING TYPE CYCLOTRON. Karasawa, T. (to Rikagaku Kenkyusho). US Patent 3,921,019. 18 Nov 1975. Priority Date 4 Dec 1972, Japan. 4p.

The design is given of a self-shielding type cyclotron which makes it unnecessary to enclose the cyclotron by an extra shielding structure to protect personnel or equipment from radiation injury or damage. (auth)

Auxiliaries and Components

Refer also to abstracts 20179 and 20951.

20967 (CERN-75-20) DESIGN OF THE CONTROL SYSTEM FOR THE SPS. Crowley-Milling, M. C. (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Dec 1975. 38p. Dep. NTIS (US Sales Only) $4.00.

After some general remarks about the requirements for the control system of large accelerators, a brief description is given of the CERN Super Proton Synchrotron. A survey is given of the evolution of the hardware and software, with particular emphasis on the reasons for the choices made. The message-transfer system, the timing system, the operator interface, the command language, and data modules are treated in detail, followed by some considerations about the protection and reliability. Finally, a preliminary assessment is made of the operation of the system for testing and commissioning parts of the accelerator equipment. (auth)

20968 (CONF-750968-6) CARBON FOILS AS HEAVY ION STRIPPERS. Yntema, J. L. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 9p. Dep. NTIS $3.50.

From 4th annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

A discussion is given of the advantages and disadvantages of thin carbon foil strippers for heavy ion beams from tandem electrostatic accelerators. Foil lifetimes were increased by radiative heating and by the evaporation of a thin layer of gold on the foil. (PMA)

Ion Sources and Injection and Extraction Systems

20969 (JAERI-M-5929) TWO-STAGE ACCELERATION OF AN ION BEAM FOR POWERFUL INJECTORS. Ohara, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Dec 1974. 20p. Dep. NTIS (US Sales Only) $4.50.

The beam divergence in a two-stage ion source was studied by calculating the beam trajectories in the space-charge limited flow. The second stage consists of a single aperture exit electrode and a spherically concave electrode. Optimum configurations of the electrodes which give a low divergence beam were obtained for aspect ratios of 1 and $\frac{2}{3}$, energy ratios of $\frac{1}{3}$ and $\frac{1}{2}$, and normalized perveances of 0.6 to 1.5. The beam divergence increases rapidly with the perveance beyond a certain critical value. The increment of the final beam divergence due to the first stage divergence is equal to the beam divergence in the first stage. (auth)

20970 (LBL-4075) EMITTANCE MEASUREMENTS OF HIGH CHARGE STATE ARGON BEAMS FROM A PIG SOURCE. Bex, L.; Clark, D. J.; Ellsworth, C. E.; Estrella, R. M.; Gough, R. A.; Holley, W. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 5p. (CONF-751048-6). Dep. NTIS $3.50.

From international conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

The emittances of beams of Ar^{4+} to Ar^{8+} were measured in the

axial and radial planes. The extraction voltage was 10 kV and the magnetic field was varied from about 0.5 to 0.6 Tesla. The anode slit was varied in distance from the arc, which was run both dc and pulsed. The emittance was nearly independent of charge state, but increased with total beam current. A small bowing of the arc column, which made evaluation of mirror field effects difficult, was discovered. (auth)

20971 (LBL-4348) CONFERENCE SUMMARY. Clark, D. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 12p. (CONF-751048-8). Dep. NTIS $3.50.

From international conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

A brief review is given of the main results presented at the International Conference on Heavy Ion Sources, October 27–30, 1975. The sections are as follows: highlights, general observations, fundamental processes in sources, positive ion sources, negative ion sources, beam formation and emittance measurements, stripping, accelerators and experiments, and future prospects. (auth)

Ion Optics and Field Calculations

20972 (BNL-50474) COMPUTER PROGRAM SIMULATING THE INTERACTION OF A PROTON BEAM WITH A RESONANT CAVITY AND AN RF CAVITY. Messerschmid, E. W. (Brookhaven National Lab., Upton, N. Y. (USA)). 29 Aug 1975. Contract E(30-1)-16. 46p. Dep. NTIS $5.00.

An up-to-date description is given of a computer program simulating the interaction of a proton beam circulating in an AG accelerator or storage ring and interacting with a resonant cavity and an rf accelerating gap. A presentation of the theory is given upon which the simulation program is based. It is followed by a formal description of the program structure and some details of the incorporated procedures. Scaling considerations of the computer model which have to be taken into account in the choice of parameters and in the interpretation of results are discussed. (auth)

20973 STUDY OF ELECTRON RING FORMATION AND EQUILIBRIUM. Kalnins, J. G. College Park, MD; Univ. of Maryland (1975). 125p. University Microfilms Order No. 75-28,757.

Thesis (Ph. D.).

The single-particle behavior of electrons in the Maryland ERA field geometry is studied in terms of the compressed ring axial velocity and orbit off-centering. Analytic equations are developed to include the effects of the cusped magnetic field, a centering coil, as well as an adiabatic compression field. The results are compared with experiment and the results of numerical integration. The axial deceleration of a thin electron ring by a resistive-wire loop is studied both analytically and numerically. For axially-extended beams, numerical simulation methods are used to show the feasibility of trapping part of the beam to form an electron ring, using a mirror-field geometry and resistive-wire loops. The equations relating the equilibrium electron ring major radius, kinetic energy, and rotation frequency to the parameters at injection are derived in a Vlasov and fluid description of the ring. The equations are solved using the calculated bias field of the ring for two ring formation schemes of interest. The results are compared with calculations by others, and the differences are analyzed. A two-fluid model is used to calculate the electron-ion radial separation in the ring as well as the bias field term for the electron-ion dipole resonance. (Diss. Abstr. Int., B)

20974 ELECTRON BEAM CHARACTERISTICS IN THE HOLLOW BEAM DIODE AND CUSPED MAGNETIC FIELD OF THE MARYLAND ERA. Hudgings, D. W. College Park, MD; Univ. of Maryland (1975). 220p. University Microfilms Order No. 75-28,754.

Thesis (Ph. D.).

The University of Maryland electron ring accelerator (ERA) concept calls for the formation of an electron ring current by transmission of a hollow relativistic electron beam through a static, azimuthally symmetric, cusped magnetic field. Electron motion is approximately paraxial in the diode and pre-cusp drift region and is axis-encircling in the post-cusp region. Experiments show the electron flow in the diode to be approximately pressureless. The radial thickness of the drifting Brillouin hollow beam is derived from a radial force balance equation. Time-resolved measurements of the beam current and energy are made by measuring the extrapolated range of the beam in aluminum targets. These measurements are analyzed with a model of the diode as a terminating impedance driven by a transmission line. Beam motion in the cusped field region is analyzed. Beam dynamics in the post-cusp region are studied by examining the interaction of a hollow rotating beam with its self-induced potentials in a cylindrical box with conducting walls and ends. The energy of the self-induced electric and magnetic potentials is much less than the kinetic energy of the beam electrons for cases approximating experimental conditions. (PMA)

Storage Rings

Refer also to abstract 20972.

20975 (BNL-50470) SCHEME FOR CURRENT ACCUMULATION IN ISABELLE USING A LOW ENERGY STACKING RING. Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 3 Oct 1975. Contract E(30-1)-16. 27p. Dep. NTIS $4.50.

A scheme for the accumulation of current in ISABELLE is proposed. The steps in the procedure are as follows: (1) The 200-MeV linac at BNL would operate with a short pulse. One turn would be injected into the AGS, accomplished with a fast kicker in the AGS appropriate for the deflection of the 200 MeV beam. (2) The single turn pulse would be captured pseudo-adiabatically and then accelerated. The resulting 12 bunches would be extracted at 29.4 GeV. A fast kicker rising between bunches would be used for this purpose. (3) The bunches would be matched and synchronously transferred to the stacking ring (SR) where sufficient current would be accumulated by the phase displacement technique used at the ISR. (4) The intense coasting beam in the SR would be rebunched into a single bunch and transferred to ISABELLE. The same fast kicker could be used for both injection into and ejection out of the SR. (5) A few such bunches would be stacked azimuthally in the ISA to achieve the final ISABELLE current. The details of the procedure are discussed, emphasizing the critical factors and significant parameters at each step. The key focal points are at 200 MeV where a space charge limitation on betatron density is encountered and at 29.4 GeV where limitations on the beam's longitudinal characteristics arise. The design procedure is given in general terms, and sample computations appropriate for ISABELLE are performed. (auth)

20976 (BNL-50471) ALTERNATE STACKING SCHEME FOR ISABELLE. Raka, E. C.; Hahn, H. (Brookhaven National Lab., Upton, N. Y. (USA)). 20 Oct 1975. Contract E(30-1)-16. 18p. Dep. NTIS $3.50.

An alternate mode of operating the AGS as an injector for ISABELLE is proposed. The required Z/n for the storage ring would thereby be increased to approximately 17.3 OMEGA from the present estimate of 4.6 OMEGA. The use of an intermediate stacking ring is also considered and the inherent limitations in increasing the required Z/n at injection are discussed. (auth)

20977 (BNL-50487) ISA "SPLIT POLE" INJECTION MAGNET. Parzen, G.; van Steenbergen, A. (Brookhaven National Lab., Upton, N. Y. (USA)). Aug 1975. Contract E(30-1)-16. 14p. Dep. NTIS $4.50.

The conceptual design for a shutterless "split pole" vertical deflecting dipole magnet for ISA beam injection is presented. Preliminary results of field mesh calculations are given together with measured data for a simple dc model. The results warrant proceeding with the further design and construction of a fast pulsed ferrite vertical injection kicker model for the ISA. (auth)

20978 (BNL-50469) EXOTIC rf SYSTEMS FOR HIGH INTENSITY HIGH ENERGY PROTON STORAGE ACCELERATORS. Claus, J.; Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 5 Sep 1975. Contract E(30-1)-16. 19p. Dep. NTIS $3.50.

High performance proton storage accelerators require the handling of intense particle beams. The transfer of a high current, low energy beam from a current accumulator ring, i.e., one of small circumference, to a large circumference ring capable of accelerating the beam to high energy, is an example. In order to prevent the longitudinal dilution which results from allowing such a beam to debunch, an rf waveform which would contain the beam azimuthally in the large ring, while at the same time being matched to the debunched beam in the small ring, is proposed. The containment is obtained by requiring that the gap voltage be reduced to zero for a large fraction of the time, this fraction being closely related to the fraction of azimuth within which the beam is to be contained. Both containment and acceleration are considered, with particular reference to the ISABELLE design parameters. (auth)

Experimental Facilities

Refer also to abstract 20310.

20979 (ANL-HEP-TR-76-02) POLARIZED PROTON TARGET-IV. Operations Manual. Hill, D.; Fletcher, O.; Moretti, A.; Onesto, F. (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. 61p. Dep. NTIS $4.50.

Standard operating procedures are presented for the vacuum, cryogenic, and electronic systems of a polarized proton target. The systems are comprised of (1) a target cryostat; (2) a ^{4}He pumping system; (3) a ^{3}He pumping system; (4) a microwave system; (5) a magnet and power supply; (6) a computerized polarization monitor; and (7) miscellaneous auxiliary equipment. (PMA)

20980 (CONF-750968-3) BEAM HEATING OF TARGET FOILS. Corwin, W. C. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 14p. Dep. NTIS $3.50.

From 4th annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

A target rotator, built to reduce the effects of beam spot heating, is fully adjustable, holds three targets, is chamber independent, and takes up limited space. The expected temperature rise in the target is calculated from the Stefan–Boltzmann law. (PMA)

20981 (CONF-750968-4) TARGET VACUUM STORAGE FACILITY. Worthington, J. N.; Jedlowski, R. J.; Thomas, G. E. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 11p. Dep. NTIS $3.50.

From 4th annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

A storage facility was constructed and is now in operation for use with targets which must be kept in a vacuum. The storage chamber of this facility will handle up to ninety targets at a pressure of 5×10^{-7} torr. Typically, targets are evaporated, moved into a small transfer chamber, and then placed in the storage chamber of the facility—all under vacuum. There are safety devices which minimize accidents. (auth)

20982 (CONF-750968-5) TARGETS FOR HIGH-RESOLUTION STUDIES WITH HEAVY-ION REACTIONS. Erskine, J. R. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 30p. Dep. NTIS $4.00.

From 4th annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

Target problems in heavy ion reaction studies are discussed, including non-uniformity in thickness effects and the inability to fully compensate for reaction-site effects, both problems becoming more serious the heavier the ion. For the non-uniformity effects, the flatness of the target is very critical. Other problems not yet solved are beam-spot heating and the buildup of carbon. (PMA)

20983 (CONF-750968-7) PREPARATION OF CALCIUM-SEPARATED ISOTOPE TARGETS USING SMALL SAMPLES. Thomas, G. E. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 17p. Dep. NTIS $3.50.

From 4th annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

Targets are routinely evaporated using a few milligram quantities of separated isotopes of calcium with reducing agents. The source to target distance is 3.0 cm with the substrate, if necessary, as thin as 15 mu g/cm^2 carbon or 100 mu g/cm^2 of gold. A tantalum closed boat, heat shield, and special collimator system are used. (auth)

20984 (CONF-750968-8) THIN FOILS FOR BEAM-FOIL SPECTROSCOPY. Berry, H. G. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 16p. Dep. NTIS $3.50.

From 4th annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

Two effects are discussed. The first involves comparing the breakage of carbon foils (5 mu g cm^{-2}) under impact of focused and non-focused beams. Under defocused beam conditions produced by x and y sweeping at frequencies of 1 kHz across the 25 mm^2 foil, breakage was reduced by a factor of 5 to 10. Secondly, we discuss the effect of tilting thin foils relative to incoming heavy-ion beams. The final surface interactions change drastically giving rise to changes in the excited heavy ion products. (auth)

20985 MASSIVE SHIELDING ADAPTED TO REMOTE MAINTENANCE METHODS. Franke, P. R. Jr. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 732-733(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20986 FERMILAB TARGET AREAS AND TARGET TRAIN SYSTEMS. Lindberg, J.; Grimson, J.; Simon, J.; Theriot, D. (Fermi National Accelerator Lab., Batavia, IL). Trans. Am. Nucl. Soc.; 22: 733(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20987 DESIGN OF THE FERMILAB NEUTRINO REMOTE TARGET MAINTENANCE SYSTEM. Simon, J.; Grimson, J.; Lindberg, J.; Theriot, D. (Fermi National Accelerator Lab., Batavia, IL). Trans. Am. Nucl. Soc.; 22: 733-734(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

20988 DESIGN OF THE FERMILAB NEUTRINO HORN TRAIN SYSTEM REFERENCED TO RADIOACTIVE MAINTENANCE. Grimson, J.; Lindberg, J.; Simon, J.; Theriot, D. (Fermi National Accelerator Lab., Batavia, IL). Trans. Am. Nucl. Soc.; 22: 734-735(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstract 21071.

20989 (CONF-730804-P3, pp 2007-2012) PROJECT OF AN ARRANGEMENT FOR THE DETECTION OF NEUTRINO RADIATION FROM COLLAPSING STARS. Chudakov, A. E.; Ryajskaya, O. G.; Zatsepin, G. T. (Inst. for Nuclear Research, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3. (Denver Univ., Colo. (USA)).

A scintillation counter containing 100 tons of liquid scintillator is mounted in a salt mine at a depth of about 700 m.w.e. The scintillator of this counter will be viewed by 128 photomultiplayers with 15 cm diameter of photocathode. The collapse of a star in the center of our galaxy can be detected if neutrino radiation energy is about 10^{52} ergs. (auth)

20990 ORION-ARM MAGNETIC MONOPOLES AND γ RAYS. Tompkins, D.R. Jr., Rodney, P.F. (Department of Physics, University of Wyoming, Laramie, Wyoming 82070). Phys. Rev. D 12: No. 9, 2610-2616 (1 Nov 1975).

It is shown that galactic-disk monopoles could yield air showers which are stochastically aligned with the local Orion-arm magnetic field and which are above the energies of similarly aligned galactic heavy nuclei. In the absence of a cosmic-ray anisotropy this method sets limits on the flux of galactic monopoles and on their production cross sections. Limits based on the cosmic-ray anisotropy at 10^{19} eV are presented. The possibility of stochastic alignment of inverse Compton photons from monopoles and 2.7 °K-black-body photons is considered. The resulting monopole-flux limits, based on the same data as those calculated by Osborne, differ significantly from Osborne's limits where the mechanism of spiral-arm alignment and galactic containment are ignored. (auth)

20991 RAPID NUCLEAR REACTIONS IN SUPERNOVAE AND COSMIC RAYS. Hilf, E. R. (Technische Hochschule, Darmstadt, Ger.); Hillebrandt, W.; Takahashi, K.; El Eid, M. F.; Kodama, T. Phys. Scr.; 10A: 132-137(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

A synopsis of the transmutations of matter in a supernova to the final stages of neutron-star matter, r-nuclei, p-nuclei and cosmic rays is given. In particular discussed are (1) the freezing-out of nuclear reactions during cooling, (2) the consequences of an improved β-decay and β-delayed neutron emission systematics for the calculations of the r-process element abundances and of its application to the estimation of the nucleosynthesis-age of the galaxy, (3) the production mechanism of the high-energy light-element cosmic rays, which we propose to originate from the neutron star's surface. (6 figures) (auth)

20992 EARLY IRRADIATION OF MATTER IN THE SOLAR SYSTEM: MAGNESIUM (PROTON, NEUTRON) SCHEME. Heymann, D.; Dziczkaniec, M. (Rice Univ., Houston, TX). Science; 191: No. 4222, 79-81(9 Jan 1976).

The occurrence of positive and negative ^{26}Mg anomalies in inclusions of the Allende meteorite is explained in terms of proton bombardment of a gas of solar composition. A significant fraction of ^{26}Mg in the irradiated gas is stored temporarily in the form of radioactive ^{26}Al by the reaction $^{26}Mg(p,n)^{26}Al$. Proton fluxes of 10^{17} to 10^{19} protons per square centimeter per year at 1 million electron volts are inferred. Aluminum-rich materials condensing from the gas phase have positive ^{26}Mg anomalies, whereas magnesium-rich materials have negative ^{26}Mg anomalies. The proton flux required to account for the observed magnesium anomalies is used to investigate possible isotopic anomalies in the elements from oxygen to argon. Detectable isotopic anomalies are predicted only for neon. The anomalous neon is virtually pure ^{22}Ne from ^{22}Na decay. The predicted amount of anomalous ^{22}Ne is about 10^{-8} cubic centimeter (at standard temperature and pressure) per milligram of sodium. (auth)

20993 COSMIC RAY STREAMING. Effect of Alfven Waves on Particles. Skilling, J. (Cambridge Univ., Eng.). Mon. Not. R. Astron. Soc.; 172: No. 3, 557-566(Sep 1975).

The motion of cosmic rays through a moving magnetized medium supporting a spectrum of hydromagnetic waves is re-examined. In different approximations, Fermi acceleration, convective motion through space, diffusive motion, and free streaming are recovered. It is shown that Fermi acceleration can greatly modify the adiabatic energy losses which have conventionally been thought to accompany convective motion of cosmic rays. This may have implications for "self-confinement" theories of cosmic ray propagation. (auth)

20994 DIFFUSE COSMIC GAMMA RAYS. Daniel, R. R.; Lavakare, P. J. (Tata Inst. of Fundamental Research, Bombay). Pramana; 5: No. 3, 107-117(Sep 1975).

A careful and objective analysis is made of the available experimental observations which claim evidence for the existence of a shoulder in the spectrum of the diffuse cosmic gamma rays in the energy range of 1–40 MeV. In this, special cognizance is taken of the experimental data and theoretical calculations of the Bombay Group. These considerations cast serious doubts on the reliability of the high flux values obtained by many experimenters in this energy region emphasizing thereby the need for great caution in interpreting the shoulder as due to cosmological effects with far reaching implications. (auth)

20995 EKSPERIMENTAL'NYE I TEORETICHESKIE OSNOVY ASTROFIZIKI KOSMICHESKIKH LUCHEI. (Experimental and theoretical principles in cosmic ray astrophysics). Dorman, L. I. Moscow; Izdatel'stvo Nauka (1975). 464p.

The book describes cosmic rays in space and their interactions with matter and magnetic fields. The propagation of cosmic rays is described by means of a kinetic equation, and mechanisms are proposed for the acceleration of cosmic rays on the sun, pulsars, and supernovae. Variations in cosmic ray intensity are classified according to terrestrial or extraterrestrial origin. Direct methods of measuring intensity variations, spectra and nuclear composition of cosmic rays are described. Statistical correlation methods of analyzing cosmic rays are presented along with methods of determining primary variations from observed secondary variations of cosmic rays. 160 figs., 34 tables, 710 references. (SJR)

Stars

Refer also to abstracts 20989, 20991, 20995, 21018–21020, 21027–21029, 21050, 21052, 21805, 21927, 21929, and 21937–21939.

20996 BEAT PHENOMENA IN THE DWARF CEPHEID AE UMa. Broglia, P.; Conconi, P. (Astronomical Observatory, Milan). Astron. Astrophys., Suppl. Ser.; 22: No. 3, 243-261 (Dec 1975).

AE UMa is an ultrashort pulsating variable. 1900 photoelectric B and V observations were carried out at the Merate Obsevatory during 1974. They enable us to determine nineteen new epochs of maximum and nineteen epochs of minimum light and to indicate a strong modulation in the light curves. The main period has been improved: $P_o = 0^d.086016883$. The residuals computed by means of P_o and the variation in the brightness of the maxima and of the minima can be accounted for by a beat phenomenon whose period is found to be: $P_b = 0^d.293616$. The secondary period follows: $P_1 = 0^d.066527$ and the ratio $P_1/P_o = 0.7734$. This ratio and the amplitudes of the oscillations relating to P_o and to P_1 are compared with those of other double mode AI Vel variables. (auth)

20997 OBSERVATIONS OF SIX SOUTHERN ECLIPSING BINARIES FOR APSIDAL MOTION. Soederhjelm, S. (Lund Observatory, Sweden). Astron. Astrophys., Suppl. Ser.; 22: No. 3, 263-283(Dec 1975).

Photoelectric UBV observations are presented for the six eclipsing binaries KX Pup, EO Vel, HH Car, AY Mus, KT Cen and GM Nor. Photometric elements are determined together with rough estimates of masses and radii. KX Pup, EO Vel, KT Cen and GM Nor are found to exhibit apsidal motion in good agreement with theory. HH Car, for which apsidal motion was previously reported, has a circular orbit and shows a distorted light-curve due to circumstellar matter. AY Mus has stopped eclipsing, apparently because of perturbations by a third body in the system. (auth)

20998 OBSERVATIONS OF THE He I λ 10830 LINE IN THE SPECTRA OF TYPE O STARS. Vreux, J. M. (Univ., Liege); Andrillat, Y. Bull. Cl. Sci., Acad. R. Belg.; 61: No. 6, 577-581(1975). (In French)

The He I λ 10830 line was observed in 44 O stars (mainly Of). Emission or P Cygni profiles are generally observed in the brightest objects (classes III and I) as well as in main sequence stars classified as Oe or Oef by P. S. Conti. In both cases one is dealing with objects with an extended atmosphere. (auth)

20999 VELOCITIES OF PULSARS AND IRREGULARITIES OF THE INTERSTELLAR MEDIUM IN THE SCINTILLATION PATTERN. Lotova, N.A.; Chashei, I.V. (P. N. Lebedev Physics

Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 3, 324-327 (Mar 1975).

A scintillation theory is developed for the interstellar medium, allowance being made for both the motion of the irregularities of the interstellar medium and the motion of a pulsar in the movement of the diffraction pattern observed on the Earth. It is shown that the drift velocity of the diffraction pattern differs essentially from the pulsar velocity. This is due to the effect of the extension of the scattering medium and the motion of the irregularities. Expressions are obtained by means of which one can, from known parameters of the cross correlation function of the scintillations (ν_{max}, τ_1, and S), obtain the pulsar velocity v_0 and the parameters which characterize the motion of the irregularities ($\bar{v}$ and σ). In contrast to interplanetary scintillations, the asymmetry of the cross correlation function of interstellar scintillations is due not only to the motion of the irregularities of the medium but also to the motion of the source itself. (auth)

21000 GALACTIC ORIENTATION OF SPECTROSCOPIC-BINARY ORBITS. Brazhnikova, E.F.; Dagaev, M.M.; Radzievskii, V.V. (All-Union Society of Astronomy and Geodesy, USSR Academy of Sciences). Sov. Astron.—AJ 19: No. 3, 333-336 (Mar 1975).

The orientation of the lines of apsides for the orbits of spectroscopic binaries listed in Bečvář's and Batten's catalogs is investigated. The periastra of binaries with period $P > 20^d$ and radial velocity $V_r < 0$ are preferentially concentrated behind the plane of projection. The lines of apsides are found to have a galactic orientation. An interpretation is suggested for the corresponding "B effect" and "E effect." A theorem is proved regarding the position of the line of apsides in a plane perpendicular to a disturbing force vector. Interaction between binary stars and the interstellar medium causes the projection of their lines of apsides on the galactic plane to be oriented parallel to the major axis of their galactic orbits. Short- and long-period binaries tend to have opposing directions of orbital motion. (auth)

21001 GRAVITATIONAL RADIATION FROM A STAR COLLAPSING INTO A DISK. Novikov, I.D. (Institute for Space Research, USSR Academy of Sciences, Moscow). Sov. Astron.—AJ 19: No. 3, 398-399 (Mar 1975).

The gravitational waves emitted when a star collapses to a disk in the Thuan–Ostriker model are analyzed. The amount of energy released in the pulse of radiation when matter is abruptly decelerated at the instant the spheroidal star flattens into a "pancake" will far exceed the energy released during the free-fall stage. Equations describing the process are given. (auth)

21002 NOTE ON STAR FORMATION BY GRAVITATIONAL FRAGMENTATION. Suchkov, A.A.; Shchekinov, Y.A. (Rostov-on-Don State University). Sov. Astron.—AJ 19: No. 3, 403-404 (Mar 1975).

The possibility of star formation by gravitational fragmentation is discussed. A lower limit exists for the mass of a fragment which can be determined by the cooling mechanism and by the opacity. The minimum mass obtained coincides with the stellar mass under both contemporary conditions and under conditions typical for the formation of first generation stars. (auth)

21003 LOSS OF STABILITY OF LOW-MASS STARS THROUGH NEUTRONIZATION. Basko, M.M.; Imshennik, V.S. (Institute of Applied Mathematics, USSR Academy of Sciences, Moscow). Sov. Astron.—AJ 19: No. 3, 286-292 (Mar 1975).

The results are reported of numerical calculations for the terminal evolutionary phase and the loss of mechanical stability in iron cores with masses of 1.21, 1.4, and 1.7 $M_\odot$. Exact equations are applied to establish the thermodynamics of the radiation and the electron-positron gas. The chemical composition at $T \gtrsim 3 \cdot 10^{9}$°K is determined from the condition of statistical equilibrium over the nuclei. The kinetics of β processes is systematically taken into account. A polytropic density distribution with $n=3$ is adopted to obtain an approximate solution of the hydrodynamical equations. In the 1.7 and 1.4 $M_\odot$ models there is a well-defined epoch at which mechanical stability is lost and the transition to the hydrodynamic-collapse phase occurs. In the 1.21 $M_\odot$ model, however, no such epoch exists; the evolution of the core on the characteristic time scale of the β processes gradually accelerates to the collapse phase. In all the models, but particularly for 1.21 $M_\odot$, the thermodynamic-nonequilibrium nature of the β processes is highly significant as it causes the entropy to rise in the central zone. The predominant contribution to the energy-loss rate in all the models is supplied by URCA neutrino radiation. The possible formation of submassive ($M < 1.0\,M_\odot$) neutron stars is discussed. (auth)

21004 OPTICAL STUDIES OF SUPERNOVA REMNANTS: THE NEBULA NEAR γ CYGNI. Lozinskaya, T.A. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 19: No. 3, 315-318 (Mar 1975).

Detailed optical observations of the nebula near γ Cyg, identified with the supernova remnant corresponding to object No. 4 in Downes and Rinehart's list of Cyg X microwave sources, have been made with the 125-cm reflector of the Shternberg Astronomical Institute's Southern Station. Interference-filter photographs of the object in the *Hα*, [*N II*], [*S II*], and [*O III*] lines have been taken. A series of interferometer observations of the nebula and the nearby *H II* region have been carried out in the *Hα* and λ6584 [*N II*] lines with a high-contrast Fabry–Pérot étalon and a contact electronic image converter. Spectrograms of the nebula at dispersions of 25, 60, and 240 Å/mm in the 6000–7000 Å range have been obtained with a grating spectrograph and an image converter. According to these observations, $I_{H\alpha} \simeq 10^{-3}$ erg·cm^{-2}·sec^{-1}·sr^{-1} (corrected for interstellar absorption), $I_{H\alpha}/I_{[NII]} = 2.4$, $I_{H\alpha}/I_{[SII]} = 7$, $I_{6731}/I_{6717} = 0.7$ and $V_{LSR} = +9 \pm 3$ km/sec. The mean halfwidths of the *Hα* and λ6584 lines over the nebula are 49 ± 5 and 39 ± 5 km/sec, respectively. The expansion velocity of the nebula does not exceed 15 km/sec. It is shown that the nebula near γ Cyg cannot be a typical envelope formed in a supernova outburst such as the Cygnus Loop, *IC* 443, and *W*28. If the nebula is instead an *H II* zone, it would have the parameters $T_e = (1-2) \cdot 10^{4}$°K, $N_e \simeq 10^{2}$ cm^{-3}, $EM \simeq 10^{4}$ cm^{-6} · pc, $M \sim 30\,M_\odot$, and $u_{(Sp)} \sim 25$ pc·cm^{-3}. The exciting star has not been found. The recombination radio emission of *DR* 4 arises from the nebula near γ Cyg, not from the diffuse background. (auth)

21005 RELATIVISTIC MAGNETOHYDRODYNAMICAL EFFECTS OF PLASMA ACCRETING INTO A BLACK HOLE. Ruffini, R. (Institute for Advanced Study, Princeton, New Jersey); Wilson, J.R. Phys. Rev. D 12: No. 10, 2959-2962 (15 Nov 1975).

By an explicit analytic solution it is shown how, in the accretion of a poloidally magnetized plasma into a Kerr black hole, a torque is exerted on the infalling gas, implying the extraction of rotational energy from the black hole. The torque arises from the twisting of magnetic field lines by the frame-dragging effect. It is also shown how, under suitable conditions, a sizable charge separation can be found in the magnetosphere of accreting black holes and hence an electric charge is expected to be induced on the black hole. (auth)

21006 GRAVITATIONAL RADIATION FROM SUPERNOVA EXPLOSIONS. Adler, R.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 and Departamento de Fisica, Universidade Federal de Pernambuco, 50.000 Recife, Brazil); Zeks, B. Phys. Rev. D 12: No. 10, 3007-3012 (15 Nov 1975).

As a simple model of a supernova explosion we study a point mass exploding into two equal point masses moving back to back at high velocity, or a superposition of such elementary explosions. We employ two calculational methods. In one method we assume an infinite acceleration for zero time and calculate the gravitational field and the distribution of emitted energy. A cutoff frequency in the power spectrum is necessary to obtain a finite total energy output. The spectrum is constant from zero to this cutoff frequency. For nonrelativistic ejecta velocities the angular distribution is typical of quadrupole radiation, while for ultrarelativistic ejecta it is isotropic. To justify the infinite-acceleration approximation, we also calculate the quadrupole aproximation, using a smooth finite acceleration, and verify the previous qualitative results in the nonrelativistic limit. A brief table of fields, energies, and fluxes is given for some reasonable supernova parameters. (auth)

21007 BLACK HOLES AND MAGNETIC FIELDS. King, A.R.; Lasota, J.P.; Kundt, W. (I. Institut für Theoretische Physik, 2 Hamburg 36, Jungiusstrasse 9, West Germany). Phys. Rev. D 12: No. 10, 3037-3042 (15 Nov 1975).

The possible stationary axisymmetric electromagnetic fields in a vacuum cavity between an initially neutral black hole and a surrounding plasma shell are investigated. It is shown that such fields must be near "uniform" (in a sense defined in the paper) and that the flux of the magnetic field across one half of the surface of a neutral hole (of fixed mass) decreases as the angular momentum of the hole increases. (auth)

21008 RELATIVISTIC SUPERDENSE MATTER IN COLD SYSTEMS: APPLICATIONS. Bowers, R.L. (Department of Physics, Texas A&M University, College Station, Texas); Gleeson, A.M.; Pedigo, R.D. Phys. Rev. D 12: No. 10, 3056-3068 (15 Nov 1975).

The fully relativistic model of the strong interactions between hyperons, described in the preceding paper, is used to investigate the properties of superdense matter. This model can be solved exactly, and the low-temperature limit applied directly to construct neutron star models. Our results lead to a significantly higher mass stability limit ($M_{\text{max}} = 2.39\,M_\odot$) which has far-reaching implications for black-hole astrophysics. It also yields moments of inertia well above the observational lower bounds for pulsars. The model predicts a phase transition which includes nuclear densities, and which has significant implications for the detailed structure of neutron stars. Despite the low central densities found for stable masses ($\epsilon_c \lesssim 2 \times 10^{15}$ g/cm^3) all members of the first SU(3) -symmetric octet except the Ξ^- enter as stable constituents. In addition, quarks may be used as fundamental constituents for a species of superdense matter applicable to models of the hyperons. Our results indicate that this approach may be fruitful in explaining such phenomena as precocious scaling and quark confinement. (auth)

21009 STATISTICAL BLACK-HOLE THERMODYNAMICS. Bekenstein, J.D. (Department of Physics, Ben Gurion University of the

Negev, Beer Sheva 84120, Israel). Phys. Rev. D 12: No. 10, 3077-3085 (15 Nov 1975).

Traditional methods from statistical thermodynamics, with appropriate modifications, are used to study several problems in black-hole thermodynamics. Jaynes's maximum-uncertainty method for computing probabilities is used to show that the earlier-formulated generalized second law is respected in statistically averaged form in the process of spontaneous radiation by a Kerr black hole discovered by Hawking, and also in the case of a Schwarzschild hole immersed in a bath of black-body radiation, however cold. The generalized second law is used to motivate a maximum-entropy principle for determining the equilibrium probability distribution for a system containing a black hole. As an application we derive the distribution for the radiation in equilibrium with a Kerr hole (it is found to agree with what would be expected from Hawking's results) and the form of the associated distribution among Kerr black-hole solution states of definite mass. The same results are shown to follow from a statistical interpretation of the concept of black-hole entropy as the natural logarithm of the number of possible interior configurations that are compatible with the given exterior black-hole state. We also formulate a Jaynes-type maximum-uncertainty principle for black holes, and apply it to obtain the probability distribution among Kerr solution states for an isolated radiating Kerr hole. (auth)

21010 PROFILE OF He I LAMBDA 5876 IN THE P-CYGNI-TYPE OF STAR HD 152408. Walborn, N. R. (Cerro Tololo Inter-American Observatory, La Serena, Chile). Publ. Astron. Soc. Pac.; 87: No. 519, 735-736(Oct 1975).

The blue-shifted absorption component of the P-Cygni profile at He I lambda 5876 in HD 152408 (O8: Iafpe) has been found to be extremely broad, extending -1000 km sec^{-1} from the emission maximum. This unusual profile is probably due to overpopulation of the lower level of lambda 5876, which permits it to form throughout a greater extent of the expanding atmosphere than most other lines. This observation confirms Hutchings' identification of very large velocities in the blue-violet spectrum of HD 152408, and in particular his interpretation of a similar feature at He I lambda 3889, which is metastable. The lambda 5876 profile in HD 152408 is compared to those in the similar but less extreme P-Cygni star HD 151804 (O8 Iaf), and in the Wolf-Rayet star HD 151932 (WN7-A). The similarity between the absorption components in HD 152408 and the WN star is striking. (auth)

21011 POSSIBLE PATHS FOR SYNTHESIS OF SUPERHEAVY ELEMENTS IN NATURE. Howard, W. M. (Univ. of Illinois, Urbana). Phys. Scr.; 10A: 138-141(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

We discuss the possibility of producing superheavy elements in the astrophysical r-process. Thus, we consider a detailed calculation of fission-barrier heights and neutron separation energies for heavy neutron-rich nuclei. The dependence of the neutron-induced fission cutoff of the r-process on the uncertainty in the nuclear models is discussed in some detail. (7 figures) (auth)

21012 DIFFRACTION OF A PLANE ELECTROMAGNETIC WAVE AT A SCHWARZSCHILD BLACK HOLE. Herlt, E.; Stephani, H. (Univ., Jena, Ger.). Int. J. Theor. Phys.; 12: No. 2, 81-93(Feb 1975).

Using the technique of Debye potentials a rigorous solution of the diffraction problem is given as a superposition of an incident wave, strongly connected with the Coulomb scattering wave function, and a scattered wave, which is purely outgoing for large distances. The solution fulfills the boundary conditions to be the light of a very distant star and to be purely ingoing at the Schwarzschild horizon. The phase shifts of the partial waves are evaluated in the WBK approximation. (auth)

21013 ARE QUASARS LOCAL. Terrell, J. (Los Alamos Scientific Lab., NM). pp 457-473 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

A discussion of the properties of pecularities of quasars is given. A review of the various observations and problems associated with quasars is presented. (JFP)

21014 NEW EYES ON THE BIRTH OF STARS. Wynn-Williams, G. (Cambridge Univ., Eng.). New Sci.; 68: No. 973, 270-272(30 Oct 1975).

The zone known as W3 in Cassiopeia is one of several regions of recent star formation in our Galaxy. These regions are being studied in detail by a combination of techniques which are described in this article. With aperture synthesis radio telescopes the newly formed O stars are found and patterns of ionized gas are mapped in great detail. Millimetre-wave spectral line studies delineate the more extensive, cooler neutral clouds, providing information on their temperatures, densities and velocities. Finally, with infrared techniques the dust in the clouds and, most important of all, the birth event itself can be observed. (UK)

21015 408 AND 5000 MHz OBSERVATIONS OF 12 PROBABLE SUPERNOVA REMNANTS. Caswell, J. L. (CISRO, Epping, Australia); Clark, D. H.; Crawford, D. F. Aust. J. Phys., Astrophys. Suppl.; No. 37, 39-56(Sep 1975).

Twelve radio sources which have been classified as probable SNRs in earlier studies have been observed with high resolution at both 408 and 5000 MHz. Improved values have been determined for their flux densities and spectral indices, and more details can now be seen in their brightness distributions. (auth)

21016 408 AND 5000 MHz OBSERVATIONS OF 28 NEW GALACTIC SUPERNOVA REMNANTS. Clark, D. H. (Univ. of Sydney); Caswell, J. L.; Green, A. J. Aust. J. Phys., Astrophys. Suppl.; No. 37, 1-38(Sep 1975).

High-resolution contour maps of surface brightness at 408 and 5000 MHz are presented for 28 new galactic SNRs. (auth)

21017 IMPROVED 408 MHz OBSERVATIONS OF SOME GALACTIC SUPERNOVA REMNANTS. Clark, D. H. (Univ. of Sydney); Green, A. J.; Caswell, J. L. Aust. J. Phys., Astrophys. Suppl.; No. 37, 75-86(Sep 1975).

High-resolution contour maps of surface brightness at 408 MHz obtained with the Molonglo radiotelescope are presented for seven galactic SNRs. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 21004 and 21015–21017.

21018 A SPHERICAL SUBSYSTEM OF GALACTIC RADIO SOURCES. Gorshkov, A.G.; Popov, M.V. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 19: No. 3, 328-332 (Mar 1975).

A statistically complete sample of flat-spectrum radio sources from the Ohio survey at 1415 MHz exhibits a concentration toward the galactic center. Calcuations show that these sources form a spherical galactic subsystem (SGS) with parameters similar to those of old populations such as globular clusters and *RR* Lyr stars. The radio luminosity of an SGS object is 10^{33} erg/sec; there are $\simeq$7000 of these objects. The existence of an SGS would explain the abnormally small slope of the (log N, log S) relation found from the high-frequency Parkes (2700 MHz) and University of Michigan (8000 MHz) surveys, because it is at high frequencies that SGS sources comprise a large proportion of all sources (50% of sources with $S>1$ *Jy* at 8000 MHz). The SGS objects probably are either thermal radio sources (H *II* regions with $T=10^4$°K, $n_e=10^3$ cm^{-3}, and $l=1$ pc) or supermassive black holes with $M \simeq 10^5\ M_\odot$. (auth)

21019 X-RAY EMISSION FROM CASSIOPEIA *A* AND THE TYCHO SUPERNOVA REMNANT. Bychkov, K.V.; Sitnik, T.G. (Special Astrophysical Observatory, USSR Academy of Sciences). Sov. Astron.—AJ 19: No. 3, 309-314 (Mar 1975).

A model developed previously for the radiation of the "nonsteady filaments" ("moving knots") in Cas *A* is applied to show that these filaments might represent the source of the soft x rays observed in the photon energy range $E=1$–10 keV. Observational tests are suggested: the structure of the x-ray emission region should be quite inhomogeneous, and the structural features should be variable on a time scale of $\simeq$10 yr. Appreciable coronal-line emission from the nonsteady filaments is possible. Detailed calculations indicate that the radiation of the interstellar gas swept up by the Cas *A* envelope should have a considerably harder spectrum than is observed. Both the rarefied nonrelativistic gas controlling the free expansion velocity of the Cas *A* envelope and the interstellar gas that has been swept up ought to produce a detectable flux density in the energy range $E=10$–300 keV. If the distance of the Tycho remnant is taken to be 1.5 kpc, the absolute flux and the x-ray spectrum of this nebula can be explained by the emission of swept-up interstellar gas at energies $E<4$ keV and of hot nonrelativistic gas in the envelope for $E>4$ keV. (auth)

21020 A MODEL FOR HERCULES *X*-1 AND THE NATURE OF THE 35-DAY CYCLE. Bisnovatyi-Kogan, G.S.; Komberg, B.V. (Institute of Applied Mathematics, USSR Academy of Sciences, Moscow). Sov. Astron.—AJ 19: No. 3, 279-285 (Mar 1975).

A model of the binary system containing the x-ray source Her *X*-1 is proposed. The central star is assumed to have a magnetic field strong enough for it to shed streams of gas. When the neutron star is embedded in a stream, the optical depth τ_s for Compton scattering of x rays will exceed unity, and the pulsar radiation will have a broad directional pattern ($\simeq$180°). In the opposite case, when $\tau_s<1$, the neutron star will have a narrow pencil beam; its radiation will strike the central star but will not proceed to the observer. The neutron star moves relative to the stream because its orbital motion is not

synchronized with the rotation of the central star. If a full orbit about the central star takes 35 days and the stream covers about 1/3 of the orbit, this model would explain some properties associated with the 35-day cycle. The variability in the length of the cycle is attributed to an irregular drift of the magnetic poles of the central star. It is predicted that a prolonged interruption of x rays should be preceded by an extended interval during which the 35-day period remains constant. The optical properties of the binary-system radiation are related to the directivity of the synchrotron radiation of anisotropically distributed electrons. When $\tau_x > 1$ the anisotropy will be small and most of the radiation will have energies above 8 keV, so that after multiple reradiation of the x rays by the central star and the disk a broad maximum will be formed in the optical range. For $\tau_x < 1$ the anisotropy will be sharper, the radiation more directive with a greater proportion at energies below 8 keV, and since x rays are almost wholly absorbed in this region the optical curve will receive an increment resembling a classical reflection effect with a narrow maximum. Some observational implications and tests for verifying the model are set forth. (auth)

21021 5000 MHz FLUX DENSITIES AND SPECTRA FOR 325 SMALL-DIAMETER RADIO SOURCES AT LOW GALACTIC LATITUDES. Caswell, J. L. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia); Haynes, R. F.; Clark, D. H. Aust. J. Phys.; 28: No. 5, 633-646(Oct 1975).

Flux density measurements at 5000 MHz are presented for 325 of the small-diameter sources detected in the Molonglo 408 MHz galactic survey. By investigating the spectra we show that probably between 10% and 15% of the sources are galactic and the remainder extragalactic. (auth)

21022 NEW RADIO MAP OF CASSIOPEIA A AT 5 GHz. Bell, A. R.; Gull, S. F.; Kenderdine, S. (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Nature (London); 257: No. 5526, 463-465(9 Oct 1975).

The radio source Cas A is believed to be the remnant of a type II supernova that existed in the Galaxy about 280 years ago. A new radio map of the source is here presented having a resolution three times greater than previously achieved. The observations were made during November 1974 using the Cambridge 5 km telescope at a frequency of 5 GHz. The overall structure of the source appears to be ring-like and presumably the two-dimensional projection of a spherical shell. The brightest part of the ring lies well inside the edge of the source, with a plateau of lower surface brightness outside. The extent of the plateau, however, varies considerably over the remnant. A new feature revealed by the observations is that the emission within the main ring shows a marked cellular structure defined by weak ridges, and such a cellular structure and the general rather chaotic appearance of the remnant is in accordance with models of young supernovae. Another feature shown by the map is the existence of a number of compact strongly emitting regions. Other features are also discussed. (UK)

21023 OBSERVATIONS OF A0620-00 AT 962 AND 151 MHz. Davis, R. J.; Edwards, M. R.; Morison, I.; Spencer, R. E. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Nature (London); 257: No. 5528, 659(23 Oct 1975).

Observations of A0620-00 at 962 MHz made on August 16 to 29 with the Mk II - III long baseline radio-link interferometer at Jodrell Bank, and also during August 12 to 15 with the Mk II radio telescope are described. The x-ray flux density showed a decreasing intensity with time. Observations are also described made on August 17 using the Mk IA Defford radio-link interferometer at 151 MHz. In the latter case no radio emission was observed; this may have been due to interstellar scattering. (UK)

21024 OPTICAL COUNTERPART OF A0620-00 BEFORE ITS ERUPTION. Ward, M. J. (Sussex Univ., Brighton, Eng.); Penston, M. V.; Murray, C. A.; Clements, E. D. Nature (London); 257: No. 5528, 659-660(23 Oct 1975).

An accurate determination of the position of the optical counterpart of A0620-00 has made identification of the image of the star on the Palomar Observatory Sky Survey charts possible. It is thought that if the optical counterpart, before eruption, is a red dwarf star this is consistent with a model for the x-ray source resembling current explanations of dwarf novae, but with a black hole or neutron star replacing the white dwarf as the body accreting material spilt from the Roche lobe of the red star. (UK)

21025 ANGULAR SIZE-FLUX DENSITY RELATION FOR EXTRAGALACTIC RADIO SOURCES. Swarup, G. (Tata Inst. of Fundamental Research, Bombay). Mon. Not. R. Astron. Soc.; 172: No. 3, 501-512(Sep 1975).

A comparison has been made of the maximum angular extents of 163 weak extragalactic radio sources observed by the method of lunar occultation at Ootacamund with those for 199 strong sources from the 3CR complete sample. The angular sizes of the 62 sources with flux densities $S_{408} \geq 16.5$ Jy (1 Jy = 10^{-26} W m^{-2} Hz^{-1}) in the All-sky catalogue of Robertson were also considered. Over a flux density range of about 0.3 to 100 Jy at 408 MHz, it is found that the median value of angular size θ_m increases with flux density S and is related approximately as $\theta_m \propto S$. A similar relation is found if the identified QSOs are excluded from the source samples. These results indicate that statistically the weaker sources are located farther away. Since both θ and S are dependent on world models, their relationship is of value for cosmological investigations. (auth)

21026 COSMOLOGY FROM ANGULAR SIZE COUNTS OF EXTRAGALACTIC RADIO SOURCES. Kapahi, V. K. (Tata Inst. of Fundamental Research, Bombay). Mon. Not. R. Astron. Soc.; 172: No. 3, 513-533(Sep 1975).

The cosmological implications of the observed angular sizes of extragalactic radio sources are investigated using the log N-log θ relation, where N is the number of sources with an angular size greater than a value θ, for the complete sample of 3CR sources, and the θ_{median} vs flux density (S) relation derived from the 3CR, the All-sky, and the Ooty occultation surveys, spanning a flux density range of about 300 : 1. The method of estimating the expected $N(\theta)$ and θ_m (S) relations for a uniform distribution of sources in space is outlined. Since values of $\theta \gtrsim 100''$ arc in the 3C sample arise from sources of small z, the slope of the $N(\theta)$ relation in this range is practically independent of the world model and the distribution of source sizes, but depends strongly on the radio luminosity function (RLF). From the observed slope the RLF is derived in the luminosity range of about $10^{23} < P_{178} < 10^{26}$ W $Hz^{-1}sr^{-1}$ to be of the form $\rho(P)\, dP \propto P^{-2.1}\, dP$. It is shown that the angular size data provide independent evidence of evolution in source properties with epoch. It is difficult to explain the data with the simple steady-state theory even if identified QSOs are excluded from the source samples and a local deficiency of strong sources is postulated. The simplest evolutionary scheme that fits the data in the Einstein-de Sitter cosmology indicates that the local RLF steepens considerably at high luminosities, the comoving density of high luminosity sources increases with z in a manner similar to that implied by the log N-log S data and by the V/V_m test for QSOs, and the mean physical sizes of radio sources evolve with z approximately as $(1+z)^{-1}$. Similar evolutionary effects appear to be present for QSOs as well as radio galaxies. (auth)

21027 ARIEL 1118-61: A VERY CLOSE BINARY SYSTEM. Pringle, J. E.; Webbink, R. F. (Cambridge Univ., Eng.). Mon. Not. R. Astron. Soc.; 172: No. 3, 493-500(Sep 1975).

The hypothesis is considered that the 6.75-min periodicity observed in the transient X-ray source Ariel 1118-61 is due to orbital motion. Such a binary system would consist of a white dwarf transferring matter on to a compact object. The average mass transfer rate is $\sim 10^{-7}\ M_\odot\ yr^{-1}$ and is driven almost entirely by gravitational radiation. This rate of mass transfer obscures the X-ray source for most of the time and a transient X-ray source is seen when the mass transfer temporarily drops below this level. (auth)

21028 GALACTIC SUPERHALOES, GLOBULAR CLUSTERS, AND HIGH LATITUDE X-RAY SOURCES. Matilsky, T. A. (Massachusetts Inst. of Tech., Cambridge). Nature (London); 257: No. 5528, 660-661(23 Oct 1975).

The observational features of unidentified high latitude x-ray sources appear to be consistent with the suggestion that they are a population of remote optically undetectable globular clusters. The principal objection to this hypothesis is the isotropy in galactic longitude of the high latitude sources. It is widely believed that the globular cluster population of the Galaxy is completely observable, but it is argued that this is not necessarily true. Observational implications are discussed. The possibility that high velocity stars form "moving groups" belonging to a halo population, is discussed. (UK)

21029 OBSERVATIONS OF RADIO SOURCES FORMERLY CONSIDERED AS POSSIBLE SUPERNOVA REMNANTS. Caswell, J. L. (CSIRO, Epping, Australia); Clark, D. H. Aust. J. Phys., Astrophys. Suppl.; No. 37, 57-73(Sep 1975).

A number of radio sources which have at some time been regarded as possible SNRs, or parts of SNRs, have been investigated. Measurements of the spectrum and, in some instances, the detection of hydrogen recombination line emission, show that most of these sources are probably not SNRs. In each of two cases a proposed large-diameter SNR appears to be predominantly thermal but contains a source which may be an SNR of much smaller size than originally suggested. (auth)

Solar Phenomena

Refer also to abstracts 19818 and 20995.

21030 NONRADIAL OSCILLATIONS OF THE STANDARD MODEL. Robe, H.; Ledoux, P. (Univ., Liege). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 3, 198-209(1975). (In French)

The nonradial oscillations of the standard model are studied numerically for values of the degree l, of the spherical harmonics ranging from l = 2 to l = 50 in the case of the g modes and l = 2 to 200 in the case of the f and p modes. It is found that for values l > 50, the eigenvalues σ^2 of the f and p modes are nearly proportional to l and that the amplitudes are only important in a superficial region, the narrower the higher the value of l. Moreover, for l in the range 400 to 800, the periods of the first p modes in the case of the sun, supposedly built on this model, vary from 3 to 5 minutes. The eigenvalues of the g modes seem to be bounded and while the corresponding amplitude remains important in the whole model, it tends to increase considerably, especially for the g_1, g_2 and g_3 modes, in the central regions as l increases. This behavior of the eigenfunctions could have interesting consequences for vibrational instability. (auth)

21031 ANALYSIS OF THE SOLAR PHOTOMETRIC SPECTRUM: A NEW APPROACH. Dingens, P.; Steyaert, H.; Baeck, N. (Ghent State Univ.). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 6, 582-588(1975).

A new very general (computer) method is proposed for decomposing the solar photometric spectrum with the aid of Gaussian components, and without making use of any information about already identified lines. The method has been applied to the wavelength range λ 6105 to λ 6150 of the solar data published by Delbouille, Neven and Roland (1973) and led to the recognition of 239 absorption lines, finding anew the 120 lines mentioned in the S.R.R.T, and multiplying by a factor of 2 the number of detected (weak) lines. An example is given to illustrate the nearly perfect reproduction obtained. (auth)

21032 NEW METHOD OF INTERPRETING LINES OF THE SOLAR SPECTRUM. Sitnik, G.F. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 19: No. 3, 337-341 (Mar 1975).

Closely spaced triplet lines that arise from a common lower level or from lower sublevels with small energy difference are used. For such lines it is assumed that both the source function in the line and the frequency dependence of the selective absorption coefficient are the same at any depth of the region of formation of the lines in the atmosphere and depend on this depth in the same way. The basic data are the residual intensities of the individual lines of the triplet measured for each line at a number of points of the profile at strictly equal distances from its center and at different distances from the center of the solar disk. They are expressed in terms of the continuum intensity in the center of the solar disk for the average wavelength of the triplet interval. Such observations enable one to avoid the usual assumption that the source function in the line is constant within the line. In fact, a frequency dependence of this function is revealed by the use of the method. Calculation in accordance with Eqs. (12) or (13) enables one to determine the source function in the line and its wavelength dependence within the line, to construct simultaneously a model of the solar atmosphere by determining the source function in the continuum from observations at points of the profile in its central part and in the wing, to find the ratio of the selective and continuous absorption coefficients as a function of the optical depth in the continuum, and to find the wavelength dependence of the coefficients of both selective absorption and selective emission at different optical depths. Equations (13) can be applied to doublet lines without constructing a model of the atmosphere, which can be assumed known. (auth)

21033 VARIATIONS IN THE INTENSITY OF PHOTOSPHERIC LINES AND THE CONTINUUM DUE TO SMALL CHANGES OF THE PHYSICAL PARAMETERS. Badalyan, O.G.; Obridko, V.N. (Institute of Terrestrial Magnetism, the Ionosphere, and the Propagation of Radio Waves, Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 3, 342-345 (Mar 1975).

Equations are derived which determine the variations in the intensities of the solar Fraunhofer lines and the continuum when there are small changes in the parameters of the model. Application of these equations to observations of facula spectra confirm the presence of an overheated layer in faculae. (auth)

21034 TEMPERATURE DISTRIBUTION IN SUNSPOT UMBRAE. Rozhavskii, F.G. Sov. Astron.—AJ 19: No. 3, 346-348 (Mar 1975).

The temperature distribution in the umbrae of "small" (umbral area of 20×10^{-6} solar hemispheres) and "average" (umbral area of 50×10^{-6} solar hemispheres) spots was calculated on the basis of observations of monochromatic scans across sunspots carried out by using the velocity spectrophotometer of the Ural University Astronomical Observatory. The temperature in such sunspots is significantly lower than the values given in the literature. (auth)

21035 DETERMINATION OF THE PHYSICAL PARAMETERS OF PROMINENCES USING STEADY-STATE EQUATIONS. Tsovookhuu, C. (Astronomical Observatory, Academy of Sciences of the Mongolian People's Republic). Sov. Astron.—AJ 19: No. 3, 349-352 (Mar 1975).

A system of steady-state equations is constructed for 10 levels and the continuum of the hydrogen atom in prominences. A method is suggested for the joint determination of the main physical parameters of prominences: the optical thickness τ_0 of the prominence at the center of the H_α line, the electron concentration n_e, the electron temperature T_e and the effective length l. (auth)

21036 ROLE OF CASCADE TRANSITIONS IN THE EXCITATION OF THE INITIAL LEVEL OF THE RED CORONAL LINE. Livshits, M.A. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 3, 353-357 (Mar 1975).

The excitation rate is calculated for the $3P^5\ ^2P_{1/2}$ level of the FeX ion due to the excitation of higher levels of configurations $3s3p^6$ and $3s^23p^43d$ and radiative decay downward. It is found that the cascade processes are equivalent to an excitation rate of $q \simeq 4.5 \cdot 10^{-9}$ cm^3·sec^{-1} for the $^2P_{1/2}$ level, more than five times greater than the rate of direct excitation from the ground state. An interpretation of observations by M. Waldmeier of the red coronal line led to $T \leq 1.3 \cdot 10^{6\circ}$K and $n_e \simeq 10^8$ cm^{-3} near the poles; from the ratio of the green and red line intensities for quiet equatorial regions with allowance for the work of D. Petrini it was found that $T \simeq 1.6 \cdot 10^{6\circ}$K. The possible role of the radial outflow of gas in the increase in the width of the red line near the poles is pointed out. (auth)

21037 OPTICAL THICKNESS AND ELECTRON CONCENTRATION OF FLARE OF AUGUST 4, 1972. Mitropol'skaya, O.N. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 19: No. 3, 358-361 (Mar 1975).

The optical thicknesses τ (Δλ) were obtained by Svestka's method from measurements of the depth of metal absorption lines located in the wings of the H_β and H_γ lines in the flare and in the photosphere. The straight line of the dependence of log τ on the logarithm of the distance of the absorption line from the center of the hydrogen line (log Δλ) is constructed by the method of least squares. It proved to be very close to the dependence expected for Stark broadening. The electron concentration n_e in the flare and the number of hydrogen atoms n_2 in the second state are determined by using the theory of the Stark mechanism for the wings of the H_β and H_γ lines: for $H_\beta n_e = (0.6 \pm 0.2) \cdot 10^{13}$ cm^{-3}; $n_2 = 1.0 \cdot 10^8$ cm^{-3} for $H_\gamma n_e = (0.8 \pm 0.6) \cdot 10^{13}$ cm^{-3}; $n_2 = 1.8 \cdot 10^8$ cm^{-3}. The line profiles of H_β and H_γ radiation in the flare are obtained with allowance for the change in an absorption line of the photosphere during the passage of its radiation through the flare layer. They differ markedly from those obtained without allowance for this change. This correction for absorption proves to be important. (auth)

21038 DEPTHS OF FORMATION OF LINES OF THE *CN* MOLECULE IN THE SUN'S ATMOSPHERE. Porfir'eva, G.A. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 19: No. 3, 362-365 (Mar 1975).

The depths of formation of lines of the weak bands of the violet system of the *CN* molecule (λ 4216 Å) are calculated by the method of weighting functions. Two models of the solar atmosphere are used. Lines with different rotational and vibrational quantum numbers are formed in almost the same layer ($\tau \simeq 0.05$–0.06). The difference between the depths of formation of the center of the line and the wing is small ($\Delta\tau_0 \simeq 0.005$). The contribution functions for the center of the sun's disk differ little from those for the edge. The calculations made are in good agreement with results obtained earlier from observations. (auth)

21039 INTERPRETATION AND APPLICATION OF THE PROBLEM OF FOUR FIXED CENTERS. Kozlov, I.S. Sov. Astron.—AJ 19: No. 3, 394-397 (Mar 1975).

A new "model problem" of celestial mechanics is further considered: the plane problem of four fixed centers, with two pairs, each having an arbitrary separation, defining $O_1\xi$ and $O_2\eta$ axes. The problem is shown to be equivalent to four model problems in celestial mechanics, and several applications to the theory of the motion of artificial or natural celestial bodies are mentioned. (auth)

21040 MODE OF PROPAGATION OF PENUMBRAL WAVES. Maltby, P. (National Measurement Labs., Sydney). Nature (London); 257: No. 5526, 468-469(9 Oct 1975).

The discovery of waves propagating outwards over sunspot penumbrae with periods of 180 to 240 sec, horizontal wavelengths of 2350 to 3800 km, and horizontal phase velocities of 12 to 25 km/sec is discussed. The theoretical interpretation of these waves has aroused considerable interest and attempts have been made to determine the precise mode of wave propagation involved. Proposed modes include Alfven waves, acoustic waves, Lamb waves, and magnetogravity waves vertically trapped at photospheric levels. Further progress will probably depend on more adequate observational knowledge of the actual propagation characteristics, including determination of the direction of the particle velocity with regard to the wave propagation vector.

The author explored the conditions of observability as a function of heliocentric angle for purely longitudinal (particle velocity parallel to propagation vector) and purely transverse (normal to propagation vector) waves, and presents observations that tend to support a predominantly longitudinal mode of propagation. Available data are, however, very limited and further observations will be necessary before any firm conclusions can be reached. (UK)

21041 OBSERVATIONS AT 6 cm OF THE SOLAR ACTIVE REGION. Kundu, M. R.; Alissandrakis, C. E. (Univ. of Maryland, College Park). Nature (London); 257: No. 5526, 465–467 (9 Oct 1975).

Precise knowledge of the fine structure of radio sources in solar active regions, and particularly their angular size and brightness temperature, is of importance with regard to the gyroresonance absorption theory of the slowly varying component, and such information is important for verifying proposed models of resonance absorption layers above sunspots. Measurements of circular polarization are also very useful. The active regions at cm wavelengths remain stable in intensity and structure for periods of about 12 hours, and consequently existing long baseline interferometers can be used to obtain synthesized maps from observations over such periods. The preliminary results are here described for a solar active region observed in May 1974 with the Westerbork synthesis radio telescope in Holland at a wavelength of 6 cm. A description of this instrument is given, together with its mode of operation, and processing of the data. A total intensity and circular polarization map for the period is shown, indicating several individual sources, the brightest source with a peak temperature of 2.5×10^6 K corresponding to one of two large sunspots. A magnetogram showed that the active region has a bipolar structure with positive polarity concentrated on the main sunspots and negative polarity scattered over the plage and some minor sunspots. The circular polarization map closely followed this configuration. (UK)

21042 ALFVEN WAVES AND MEYER'S SUNSPOT MODEL. Wilson, P. R. (Sydney Univ.). Mon. Not. R. Astron. Soc.; 172: No. 3, 535-543(Sep 1975).

The recent account of the growth and decay of a sunspot by Meyer, Schmidt, Weiss & Wilson is compared with models exhibiting a large emission of Alfvén flux. It is shown that a composite model which involves both modified convection and Alfven waves within the sub-surface flux rope can overcome some of the difficulties faced by either type of model independently. It is shown that interactions between convective motions and the flux may give rise to twists in these tubes. The significance of these twists in relation to the decay of the spot magnetic field and the appearance of the moving magnetic features in the moat is discussed. An approximate distribution of the radiative, convective and hydromagnetic energy flux in the neighborhood of a stable 1-spot is suggested on the basis of the composite model. (auth)

21043 NEW MEASUREMENTS OF ULTRAVIOLET SOLAR RADIATION IN THE STRATOSPHERE. Simon, P. (Institut d'Aeronomie Spatiale de Belgique, Brussels). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 399-409(1975). (In French)

New measurements of the solar flux in the wavelength bands 196 to 230 nm and 284 to 354 nm were made in the stratosphere with an Ebert-Fastie spectrometer of focal length 25 cm with a pass-band of 0.6 nm. The instrument was on a stabilized stratospheric gondola and was directed towards the sun. The ultraviolet solar spectra obtained with various solar zenith angles lead, by extrapolation to zero air-mass, to the determination of the magnitude of the extraterrestrial solar flux. Below 225 nm the newly measured values are lower than those generally adopted, the apparent temperature of the sun being of the order of 4700 K at 200 nm. Between 225 nm and 310 nm they are in good agreement with Broadfoot (1971) and for wavelengths greater than 310 nm they agree with Arvesen et al. (1969).

Galaxies

Refer also to abstract 20999.

21044 INVESTIGATION OF A PREFERRED ORIENTATION OF GALAXIES IN PAIRS AND SCATTERED GROUPS. Karachentsev, I.D.; Fesenko, V.I. (Special Astrophysical Observatory, Academy of Sciences of the USSR and Pskov State Pedagogical Institute). Sov. Astron.—AJ 19: No. 3, 400-402 (Mar 1975).

The distribution according to position angles and twisting direction of spiral structure of isolated pairs of galaxies from the catalog of I. D. Karachentsev does not reveal indications of preferred mutual orientation of the components. A slight positive correlation of the apparent flattenings of galaxies is observed in pairs and scattered groups that can indicate a correlation of the true flattenings of members of systems. (auth)

21045 BRIGHTNESS DISTRIBUTION AND FLUX DENSITY OF THE CRAB NEBULA IN THE 1.7–3.7 mm WAVELENGTH BAND. Zabolotnyi, V.F.; Kostenko, V.I.; Slysh, V.I. (P. K. Shternberg State Astronomical Institute of the Institute for Space Studies of the Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 3, 405-406 (Mar 1975).

The article describes a technique for the results of measurements of the brightness distribution of the Crab nebula with a resolution of 2′ in the 1.7–3.7 mm wavelength band as well as results of such measurements. Integration of the isophotes yields $(2.85 \pm 0.25) \times 10^{-13}$ W/m^2 for the total flux of the radiation power. (auth)

21046 VARIABILITY OF THE EMISSION-LINE SPECTRUM IN THE NUCLEUS OF THE SEYFERT GALAXY NGC 7469. Pronik, I.I. (Crimean Astrophysical Observatory, USSR Academy of Sciences). Sov. Astron.—AJ 19: No. 3, 293-298 (Mar 1975).

The Balmer emission lines in the gaseous envelope of the NGC 7469 nucleus have intensities and profiles that are variable on a time scale of $\simeq$20 days. At the base of the profile the *Hα* line is twice as narrow as *Hγ*. The hydrogen envelope of this Seyfert-galaxy nucleus is highly nonuniform in density. Flares occur in its dense inner portion. Emission is observed from that zone prior to a flare, but during the flare the emission comes from the more extended and rarefied part of the envelope. Some physical parameters are estimated for the dense inner part: radius, $(1.6-5) \cdot 10^{16}$ cm; electron density, $(1-10) \cdot 10^8$ cm^{-3}; and electron temperature, $(2-3) \cdot 10^4$°K. The opacity of the envelope in the Lyman-α line is discussed. The intensity variations of the λ3727 [*O* II] and [*O* III] N_1+N_2 lines indicate that the physical conditions are also variable in the forbidden-line emission zone. (auth)

21047 THE INTERACTING GALAXY PAIR NGC 5194-5195. Vorontsov-Vel'yaminov, B.A. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 19: No. 3, 299-304 (Mar 1975).

In 1958 the author selected the double galaxy NGC 5194/5 as the prototypical example of 33 "systems of the *M*51 type," wherein a companion galaxy is actually situated at the end of a spiral arm of the primary. The nature of the connecting links between such interacting galaxies was thereby elucidated. Calculations by A. and J. Toomre, however, suggest that in *M*51 the mass connection is illusory; in their model the tip of the NGC 5194 (abbreviated *M I*) spiral arm is projected by chance onto the companion (*M II*), located 11 kpc beyond. By an ingenious choice of parameters they regard *M II* as orbiting *M I* nearly perpendicular to its plane (e=0.8, q=6.6 kpc) so as to generate a tidal bridge and tail in *M I*. It is here shown that *M II* is an active young galaxy of type *SB*0/a; it has a hot nucleus, emits radio and infrared radiation, and is compact and enriched in dust. Its luminosity $M_{pg} \leq 20$, and its mass might even exceed that of *M I* (in the Toomres' calculation of tidal perturbations the mass of *M II* was taken as 1/4 that of *M I*). The integrated self-absorption of *M II* together with its absorption in the *M*51 system exceeds 2^m. In *M I* there is only one set of spiral arms, not two, and there is no trace of the tidal bridge and tail predicted theoretically for *M II*. With short exposures *M II* exhibits a bright nucleus, a feature absent from *E* and Irr galaxies. On long exposures the familiar thin northeastern arm of *M II* is accompanied by several streams of bright and dark material connecting *M II* with another arm of *M I*. These streams extend *N–S*, while the arm here runs *E–W*, despite the fact that the thin *E* arm represents a prolongation of the regular *S* arm. Apart from this optical striation the space between the component galaxies in the plane of the sky is filled with strong radio emission, even though *M II* shows no evidence of *H I*. Still longer exposures reveal a bright halo around *M II* whose southern portion is projected onto *M I*, apparently obscuring it. Accordingly, *M II* would seem to be in front of *M I*, not behind it, as assumed in the Toomres' model. That assumption also rested on the large relative red shift of *M II*, which is inconsistent with a site in the *M I* plane; but the *M I* velocity field fluctuates by as much as 100 km/sec. Although a companion galaxy on the tip of a spiral arm can gradually recede through transfer of angular momentum by gravitational torque, *M II* actually is not a companion but more likely a compact member galaxy in its own right with a large mass and luminosity. Whatever the true geometrical and dynamical interpretation of *M*51 itself may be, there is no need to abandon the term "systems of the *M*51 type," of which the author has now identified about 160 examples. (auth)

21048 EVOLVING HOMOGENEOUS MODEL STELLAR SYSTEMS. Astaf'ev, E.R. (Rostov-on-Don University). Sov. Astron.—AJ 19: No. 3, 305-308 (Mar 1975).

An investigation is made of the time evolution in homogeneous spheroidal model stellar systems composed of identical stars. Initial system parameters are considered in the following ranges: mass, 10^9–10^{12} $M_\odot$, density, 100–0.05 $M_\odot$/pc^3; axial ratio, 0.9–0.4. All the models become denser as they evolve, but they may become either more or less spherical, depending on the angular momentum carried away by the stars during the relaxation time. The lifetime of a model from its initial to its final state and the rise in density during this characteristic time depend only on the initial axial ratio. (auth)

21049 UBV PHOTOMETRY OF COLLINDER 463. Townsend, R. E. (San Diego State Univ., CA). Publ. Astron. Soc. Pac.; 87: No. 519, 753-757(Oct 1975).

Collinder 463 is a relatively poor galactic cluster located near the edge of the Orion arm at a distance of 650 parsecs. The cluster is found to have an age of 1.5×10^8 years and probably contains at least three giants. Differential reddening of 0/sup m/8 across the cluster yields an estimate for R which is consistent with the currently adopted value. (auth)

Cosmology

Refer also to abstracts 21026, 21922, 21930, 21932, and 21939.

21050 POSSIBLE FORM OF GRAVITATIONAL RADIATION PULSES. Vyatchanin, S.P.; Plotnikov, G.S. (M. V. Lomonosov Moscow State University). Sov. Astron.—AJ 19: No. 3, 322-323 (Mar 1975).

The profile of the gravitational radiation pulses emitted by a cluster of superdense stars is considered. An expression is obtained for the force acting on test masses in a laboratory. Numerical estimates are made. (auth)

21051 OMNES TRANSITION IN MODEL FIELD THEORIES. Garvey, R. H. University Park; Pennsylvania State Univ. (1974). 131p. University Microfilms Order No. 75-19,759.

Thesis (Ph. D.).

A survey of the existing macroscopic charge-conjugate-symmetric cosmologies is presented, including a description of the Omnes transition in which matter and anti-matter may possibly separate. This separation mechanism is examined in the context of several field-theoretic models. First, a repulsive potential model is presented which describes a system of B and anti B-particles in which there is an explicit repulsion between the B and anti B-particles. With the model made macroscopically charge-conjugate-symmetric, it is shown that, in the Hartree approximation, above a certain critical temperature, it is possible for the number of B-particles and the number of anti B-particles to be unequal in the volume considered. The nonrelativistic Zachariasen model, and a nonrelativistic Lee model are discussed. (Diss. Abstr. Int., B)

21052 QUASISPHERICAL GRAVITATIONAL COLLAPSE. Szekeres, P. (Department of Mathematical Physics, The University of Adelaide, Adelaide, Australia). Phys. Rev. D 12: No. 10, 2941-2948 (15 Nov 1975).

A previously derived class of solutions representing gravitationally collapsing dust clouds is investigated in detail. The class includes all spherically symmetric collapses but is more general and is termed quasispherical. Most features of spherical collapse appear to go over in their essentials to the more general class. Under reasonable initial conditions the singularity is hidden behind an event horizon, but with slightly irregular initial density distributions portions of the singularity become naked. The latter feature is not restricted to the nonspherical case and will in general appear in situations such as collapsing spherical shells of matter. (auth)

21053 HADRON PHYSICS AND PRIMORDIAL BLACK HOLES. Chapline, G.F. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. D 12: No. 10, 2949-2954 (15 Nov 1975).

The implications for hadron physics of astrophysical observations relating to primordial black holes are discussed. If one assumes that fluctuations in the space-time metric at very early times were scale invariant then the speed of sound in the primordial fireball must exceed 0.01c at times earlier than 10^{-12} sec, as a consequence of observational limits on primordial black holes. This suggests that superbaryons probably do not exist. It is further shown that black holes with masses $< 10^{25}$ g are unlikely to exist in nature unless either the spectrum of density fluctuations or the equation of state of dense hadronic matter behave in a rather special way. (auth)

21054 LARGE NUMBERS HYPOTHESIS AND ITS CONSEQUENCES. Dirac, P. A. M. (Florida State Univ., Tallahassee). pp 443-455 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

The consequences of adopting both the large numbers hypothesis and the Miln hypothesis. The total mass of the universe expressed in units of the proton mass is considered. Experimental tests for varying G and microwave radiation are discussed. (JFP)

21055 ACCELERATING UNIVERSE. Gunn, J. E. (Hale Observatories, Pasadena, CA); Tinsley, B. M. Nature (London); 257: No. 5526, 454-457(9 Oct 1975).

New data on the Hubble diagram, combined with constraints on the density of the Universe and the ages of galaxies, suggest that the most plausible cosmological models have a positive cosmological constant, are closed, too dense to make deuterium in the big bang, and will expand for ever. Possible errors in the supporting arguments are discussed. (auth)

21056 DENSITY FLUCTUATIONS IN AN EXPANDING VISCOUS AND CONDUCTING UNIVERSE. Simon, R. (Univ., Liege). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 416-433(1975).

The effect of viscosity and thermal conductivity on density fluctuations in a hot Einstein-de Sitter expanding universe is investigated in the frame of classical hydrodynamics in the gaseous period after decoupling. Initial conditions are taken as general and density fluctuations evolve according to a superposition of two acoustic modes and one conductive mode, which are all exponentially damped when irreversible effects become important. Isochoric initial perturbations are shown to yield a transfer function which has a maximum at a mass typical of a globular cluster. (auth)

21057 LETTERS FROM EINSTEIN TO DE SITTER ON THE NATURE OF THE UNIVERSE. Kahn, C.; Kahn, F. (Sterrewacht, Leiden). Nature (London); 257: No. 5526, 451-454(9 Oct 1975).

The correspondence between Einstein and de Sitter during 1916 and 1918, recently discovered in the archives of the Sterrewacht at Leiden, provides a fascinating glimpse of the thinking of the two principal progenitors of modern cosmology. These letters are here reproduced and discussed. (auth)

Planetary Phenomena

21058 FIFTH-APPROXIMATION SYSTEM OF EQUATIONS FOR THE THEORY OF FIGURE. Zharkov, V.N.; Trubitsyn, V.P. (Institute of Earth Physics, USSR Academy of Sciences). Sov. Astron.—AJ 19: No. 3, 366-372 (Mar 1975).

A system of equations for the theory of figure is obtained in the fifth approximation. The equations are expressed in terms of a generalized radius and the mean radius. (auth)

21059 WAVELENGTH DEPENDENCE OF LIMB DARKENING ON JUPITER. Teifel', V.G. (Astrophysical Institute, Kazakh Academy of Sciences, Alma-Ata). Sov. Astron.—AJ 19: No. 3, 373-377 (Mar 1975).

Minnaert's empirical equation is shown to be applicable for convenient analytic and graphical representation of the theoretically calculated distribution of absolute reflectivity over the disk of a planet surrounded by a homogeneous semi-infinite atmosphere. The dependence of the limb-darkening parameter k on the brightness coefficient r_0 at the center of the disk is established for isotropic, trinomial, and the Henyey–Greenstein scattering functions. The wavelength dependence of k according to 1962 and 1964 observations of Jupiter's equatorial belt is described. A comparison of the observed and theoretical k (r_0) relations shows a significant disparity: the asymmetry of the scattering function for the cloud layer diminishes toward short wavelengths. This effect may result from a substantial contribution of Rayleigh scattering to the reflected radiation in the short-wave range, arising either from gaseous constituents inside the aerosol layer or from a purely gaseous atmosphere above the clouds. In the latter case the equivalent H_2 scattering path in the outer atmosphere would have an upper limit of 9–11 km-atm. (auth)

21060 THE BLUE CLEARINGS ON MARS IN AUGUST AND SEPTEMBER 1971 AND THEIR RELATION TO DUST CLOUDS. Prokof'eva, V.V.; Chuprakova, T.A.; Dzyamko, S.S.; Bryzgalova, T.V. (Crimean Astrophysical Observatory, USSR Academy of Sciences). Sov. Astron.—AJ 19: No. 3, 378-384 (Mar 1975).

A photometric analysis of television pictures of Mars at ultraviolet, blue, green, and red wavelengths shows that the blue-clearing effect is associated with the appearance of dust clouds above light regions on the planet. The dust interpretation of blue clearings suggested by one of the authors in September 1972 is thereby confirmed; the blue-clearing illusion results from a rise in the brightness of light surface areas when dust clouds develop above them. (auth)

21061 INFLUENCE OF MESORELIEF ON THE BRIGHTNESS DISTRIBUTION OVER A PLANETARY DISK. Akimov, L.A. (Khar'kov University Observatory). Sov. Astron.—AJ 19: No. 3, 385-388 (Mar 1975).

The effect of gentle large-scale irregularities on the brightness distribution over a planetary disk is discussed. Definitions are given for macro-, meso-, and microrelief. For a planet with a very rough surface the brightness distribution law $B(\lambda,\phi,\alpha) = B_0 L(\alpha)[(\pi-\alpha)/\pi]\{\cos[\pi/(\pi-\alpha)][\lambda-(\alpha/2)]/\cos\lambda\}$ is obtained; here ϕ, λ denote the photometric latitude and longitude of a given area on the disk, α is the phase angle, B_0 is the brightness at opposition, and $B_0 L(\alpha)$ represents the limb brightness [$L(0) = 1$]. The applicability of this law to the moon is considered. (auth)

21062 BRIGHTNESS VARIABILITY AND FLARES IN COMETS. Mokhnach, D.O. (Central Astronomical Observatory, USSR

Academy of Sciences, Pulkovo). Sov. Astron.—AJ 19: No. 3, 389-393 (Mar 1975).

The surface-brightness distribution in a comet head during periods of rise, fall, and flare in the brightness is investigated theoretically. This distribution is tabulated for an initial particle velocity v_0=3 km/sec, a radiation-pressure acceleration g=0.1 and 0.5 cm/sec^2, and various circumstances of brightness variation. The center of inertia of the comet is shown virtually to coincide with the observed center of brightness. The brightness distribution and spectrum ought to be studied by improved techniques, with exposures no longer than a few seconds. The development of brightness variations and flares can be followed by securing data at intervals as short as possible. (auth)

21063 DENSITY DISTRIBUTION IN A SELF-GRAVITATING LIQUID SPHERE OF CONSTANT COMPRESSIBILITY. Longman, I. M.; Levin, D. (Tel Aviv Univ., Ramat, Israel). J. Comput. Phys.; 18: No. 4, 347-359(Aug 1975).

A spherical gravitating liquid planet without spin and having uniform temperature cannot be stable unless the Adams–Williamson condition relating density distribution and compressibility holds throughout the sphere. It is assumed that spherical symmetry obtains, in that the compressibility and density are functions only of the distance from the center of the sphere. Now although constant compressibility is not to be expected as a general feature, it seems a basic question to consider what the distribution of density in such a sphere would be if the compressibility were constant. This paper gives the density distribution as well as the gravity acceleration distribution. The latter is found to exhibit some interesting features. (auth)

21064 PIONEER 10 PLASMA ANALYZER RESULTS AT JUPITER. Wolfe, J. H. (Ames Research Center, Moffett Field, CA). pp 279-296 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1975).

Results of the Pioneer 10 observations of the environment of the planet Jupiter are discussed. The Pioneer mission and the plasma analyzer instrumentation are first described briefly. The section on the solar wind–Jupiter interaction presents ion spectra and locations of the Jovian magneto-sheath boundary observed from shock and magnetopause crossings. The magneto-sheath flow field was investigated; half-hour averages are given for proton isotropic temperature, proton number density, and proton bulk velocity. Magnetospheric plasma properties are tabulated, and the shape and dynamics of the magnetosphere are discussed at some length. (5 figures, 2 tables) (RWR)

21065 INTENSITY DISTRIBUTION OF INTERPLANETARY SCINTILLATION AT 408 MHz. Milne, R. G. (Univ. of Sydney). Aust. J. Phys.; 28: No. 5, 621-632(Oct 1975).

It is shown that interplanetary scintillation of small-diameter radio sources at 408 MHz produces intensity fluctuations which are well fitted by a Rice-squared distribution, better so than is usually claimed. The observed distribution can be used to estimate the proportion of flux density in the core of "core-halo" sources without the need for calibration against known point sources. (auth)

21066 HOST PHASE OF A STRANGE XENON COMPONENT IN ALLENDE. Lewis, R. S.; Srinivasan, B.; Anders, E. (Univ. of Chicago). Science; 190: No. 4221, 1251-1262(26 Dec 1975).

The host phase of an enigmatic Xe component in the Allende meteorite, which may have been produced by spontaneous fission of an extinct super-heavy element has been isolated. The fission Xe resides in a minor fraction comprising 0.5 percent of the meteorite, and consisting of chromite, an unknown Cr, Fe-mineral (Q, possibly a sulfide), and amorphous carbon. More than one-half of the trapped noble gases in the meteorite are located in these three minerals. Mineral Q contains gases of essentially solar isotopic composition (most of the Ar, Kr, and Xe, and some He and Ne) while chromite-carbon contains gases of strongly fractionated isotopic composition (Ne, Ar, Kr enriched in heavy isotopes, and Xe enriched in light isotopes). Both gas components, and the progenitor of the fission Xe, may have been trapped in these minerals when they formed from the solar nebula. (auth)

21067 EXTINCT SUPERHEAVY ELEMENT IN THE ALLENDE METEORITE. Anders, E.; Higuchi, H.; Gros, J.; Takahashi, H.; Morgan, J. W. (Univ. of Chicago). Science; 190: No. 4221, 1262-1271(26 Dec 1975).

An effort has been made to identify the extinct superheavy element that was present in meteorites and decayed to $^{131-136}$Xe by spontaneous fission. To characterize its chemical properties, we have measured 26 trace elements in six mineral fractions from the Allende C3 chondrite that were enriched up to 180-fold in fission Xe. The superheavy element turned out to reside mainly in a rare mineral associated with chromite (probably a Fe, Ni, Cr, Al-sulfide), comprising only 0.04 percent of the meteorite. It is accompanied by volatile, sulfide-seeking elements such as Tl, Bi, Pb, Br, I, and the heavy noble gases Ar, Kr, and Xe, all of which apparently condensed with this mineral when it formed in the solar nebula at some temperature between 400^0 and 500^{0}K. Of the nine volatile superheavy elements 111 to 119, only 115, 114, and 113 are expected to condense as sulfides in that temperature interval. Presumably at least one of these elements has an isotope with a half-life in the range 10^7 to 10^8 years: too short to survive to the present day, but long enough to leave detectable effects in meteorites. (auth)

21068 MECHANISM OF PLANETARY MAGNETIC DYNAMOS. Dolginov, Sh. Sh. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 3, 326-332(1975).

Translated from Kosm. Issled.; 13: No. 3, 367-374(1975).

It is postulated that the dynamo fields of the planets are proportional to $\tau \cdot F_p$, where $\tau = L^2/\eta$ is the lifetime of the field in a core with dimensions L and electrical conductivity σ, and F_p is the inertial force arising in a planet rotating with angular velocity ω about an axis precessing at the rate Ω; $F_p = [\omega \times \Omega] \times r$ (Poincaré force). Then $H_0 \sim (L^3/\eta)\ \omega\Omega \sin\alpha$, where $L = R_c$ is the radius of the liquid core, and $\eta = c^2/4\pi\sigma$ is the magnetic viscosity. The existence of a simple dependence between the dipole fields of the Earth and the planets has been established. (auth)

21069 SATELLITE MEASUREMENTS OF THE GRAVITATIONAL RADIO-FREQUENCY SHIFT. Chikhachev, B. M.; Ivanov, N. E.; Fedorenko, G. M.; Korchak, A. A.; Stakhanov, I. P.; Belyi, V. V.; Boldovskaya, I. G.; Kormitskaya, E. A. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 3, 339-345(1975).

Translated from Kosm. Issled.; 13: No. 3, 381-388(1975).

The results are reported of measurements of the gravitational frequency shift in the radio range with a maser carried by the Kosmos 145 satellite, which was placed in an elliptic orbit on March 3, 1967 (perigee 220 km, apogee 2135 km). All the ground-based and satellite instruments, including the three masers at the ground station, were tested in 1965 with the Kosmos 97 satellite; the relative frequency drift $\Delta f/f$ during a telemetry period was found to be $\approx 10^{-11}$. After exclusion of ionospheric effects, the observed gravitational frequency shift is consistent in amplitude (within the 30% experimental error) and sign with the theoretical value. (auth)

21070 CAUSES OF THE PREDECREASES AND FORBUSH DECREASES IN THE LIGHT OF DIRECT DATA ON THE STRUCTURE OF INTERPLANETARY PLASMA STREAMS. Mikerina, N. V.; Ivanov, K. G. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 3, 389-391(1975).

Translated from Kosm. Issled.; 13: No. 3, 433-436(1975).

The model of a stream of interplanetary plasma proposed by Hundhausen and its recent modification leads to several different assumptions concerning the structure and causes of the brief decreases in the intensity of galactic cosmic rays. The modified model differs from Hundhausen's model by the presence of a strong discontinuity R_I, similar in properties to the boundary magnetospheric discontinuity and located between the shock front S and the front R_{II} of the "flare" plasma rich in helium, as well as by the presence of a "magnetic region" bounded downstream by the discontinuity R_I and characterized, in particular, by maximum values of the modulus F of the magnetic field. The hydrodynamic meaning of the model is that the "magnetic region" together with the region of "flare" plasma located within it are a three-dimensional formation moving with supermagnetosonic velocity relative to the wind, disturbing the solar wind and being deformed during the interaction with it, similar to what takes place as a result of the interaction of the solar wind with the magnetosphere. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

21071 (CONF-730804-P3, pp 2021-2031) COSMIC RAY NEUTRINO-INDUCED MUON SPECTRUM AND THE INELASTIC NEUTRINO CROSS SECTION AT HIGH ENERGIES. Bergeson, H. E.; Cassiday, G. L.; Hendricks, M. B. (Univ. of Utah, Salt Lake City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3. (Denver Univ., Colo. (USA)).

The results of a measurement of the integral energy distribution of the neutrino-induced muon flux deep underground using the Utah neutrino detector are reported. By comparing the observed and expected distributions, lower limits are set on the saturation energy E_0 of the total neutrino-nucleon cross section or, equivalently, on the mass M/sub w/ of the intermediate vector boson if scale invariance of the inelastic structure function nu W_2 is assumed. At the 1, 2, and 3 sigma levels of confidence M/sub w/ is greater than 8.5, 4.5, 2.8 GeV or E_0 is greater than 230, 165, 25 GeV respectively. (auth)

21072 APPLICATION OF A GLASS-SEALED LANGMUIR PROBE TO IONOSPHERE STUDY. Oyama, K.; Hirao, K. (Institute of Space and Aeronautical Science, University of Tokyo, Komaba, Meguro, Tokyo, 153, Japan). Rev. Sci. Instrum. 47: No. 1, 101-107 (Jan 1976).

A glass-sealed Langmuir probe was developed to get accurate information on the ionospheric plasma. An electrode sealed in a glass tube is first baked in low pressure and tipped off the pumping system to keep the electrode surface clean. An essential advantage of the glass-sealed Langmuir probe is that it will not require the rapid sweeping of a probe voltage for reliable data acquisition. It is noted that the glass-sealed Langmuir probe is strongly recommended for the measurement of energy distribution of thermal electrons by the second harmonic method. (auth)

21073 EFFECTS OF IONOSPHERIC IRREGULARITIES ON RADIO WAVES. I. Phase Path Changes. Robinson, I.; Dyson, P. L. (La Trobe Univ., Bundoora, Australia). J. Atmos. Terr. Phys.; 37: No. 11, 1459-1467(Nov 1975).

The effects of ionospheric irregularities on the phase path of radio waves reflected at vertical incidence are studied using model irregularities. The basic approach used is quite general in that irregularities and background ionospheres of arbitrary shape may be considered. Simple triangular shaped irregularities have been used to demonstrate the application of the method and to illustrate the major effects of irregularities on the phase path. For the ionospheric conditions considered, irregularities below the level $X \sim 0.9$ have relatively little effect on the phase path of ordinary rays. Irregularities extending above this level produce relatively large effects because the refractive index varies most rapidly near the reflection level. The increased effect of irregularities near the reflection level is not as dramatic in the extraordinary ray case because the refractive index does not change quite as rapidly near the reflection level as it does in the ordinary ray case. When the reflection height is changed by the irregularity the situation is complex because different effects produce opposite changes in the phase path. The result is that an irregularity of a given percentage intensity has its maximum effect on the phase path when it is centered just below the reflection height. The phase path change produced by an irregularity is very dependent on the irregularity intensity and background gradient of the ionospheric bus is less sensitive to changes in irregularity thickness. Possible applications of the results to experiments are discussed. (auth)

21074 INVESTIGATION OF NONLINEAR PHENOMENA WHEN A POWERFUL RADIO PULSE IS PROPAGATING IN THE LOWER IONOSPHERE. Gurevich, A. V.; Shlyuger, I. S. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1237-1260(1975). (In Russian)

Nonlinear effects of self-action and interaction of radio waves in the ionosphere are investigated during the propagation of high-power radio pulses at the frequency close to the electron gyro-frequency. A strong distortion of the shape of a pulse reflected from the ionosphere which is caused by self-action is discovered. It is established that at the daytime for an ordinary wave, the absorption increases sharply, beginning from some power value and the stationary level of a signal reflected from the ionosphere decreases with the growth of the radiation power ("saturation" effect). For the extra-ordinary wave, for not too high power, on the contrary, the weakening of the absorption (plasma "translucence" effect) is observed. The interaction between a powerful pulse and radio waves of continuous (f_2 = 254 kHz, f_2 = 394 kHz) and pulsed radiation (f_2 from 0.5 to 6.5 MHz) is investigated, as well as the powerful continuous wave cross-modulation. A deep cross-modulation (up to 90%), strong, distortion of the envelope form and frequency doubling at cross-modulation ("overmodulation" effect), suppression of a wave f_2 by a powerful wave (nonlinear attenuation up to 30 dB) and the reverse effect of plasma translucence (amplification of a wave f_2 affected by a powerful wave f_1) are observed. The change in the layer properties E_s affected by the powerful wave field caused apparently by the increase in the electron density is discovered. The results of the experiment are compared with the theory which takes into account the electron heating by the wave field in the lower ionosphere. It is shown that the electron temperature at the heights 70-80 km increases approximately 20 times under the action of a powerful pulse. The excitation of a parametric instability in the wave reflection region in the ionospheric E region is pointed out. (auth)

21075 PLASMA LAMINATION IN THE POWERFUL RADIO WAVE REFLECTION REGION IN THE IONOSPHERE. Vas'kov, V. V.; Gurevich, A. V. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1261-1272(1975). (In Russian)

The self-action of powerful radio waves in the upper ionosphere caused by the electron heating is considered. The self-focusing type instability is shown to take place which results in a large-scale lamination of the ionospheric plasma in the radio wave reflection region. The instability increments are determined, their power dependence is investigated. An ordinary radio wave is shown to produce more intensive perturbations in plasma than the extraordinary wave does. (auth)

21076 SCATTERING OF AN ORDINARY WAVE NEAR THE REFLECTION POINT BY SMALL-SCALE IRREGULARITIES. Mityakov, N. A.; Rapoport, V. O.; Trakhtengerts, V. Yu. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1273-1278(1975). (In Russian)

The conversion of an ordinary wave into the extraordinary one (z-mode) by small-scale plasma irregularities extended along the magnetic field is considered. The futher scattering of a slow extraordinary wave results in z-wave diffusion in the space of wave numbers with their further attenuation due collisions. The inverted transformation process into an ordinary wave is ineffective. It is shown that the ordinary wave is reflected from the ionospheric F layer, the irregularities with scales $l \leq \lambda$ and $\sqrt{\delta N^2} \sim 3.10^{-3}$ produce a marked anomalous attenuation of a signal. The considered mechanism of wave transformation explains the effect of anomalous radio wave attenuation in the experiments on powerful ionospheric heating. (auth)

21077 GLOBAL DISTRIBUTION OF SHORT RADIO WAVE ADSORPTION IN THE IONOSPHERE. Tashentsova, I. A.; Fishchuk, D. I.; Tsedilina, E. E. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1279-1287(1975). (In Russian)

The method and accuracy of calculation of absorption of radio waves propagating in wave ionospheric channels (IWC) are considered. On the example of the ionospheric model for quiet equinox conditions of the minimum of the solar activity the F, FE, E absorption distribution over IWC is obtained and discussed as well as the upper and lower limits of the global absorption distribution of radio waves propagating the range 7-22 MHz in IWC and, in particular, the absorption of round-the-world signals. (auth)

21078 PARAMETRIC EXCITATION OF IONOSPHERIC IRREGULARITIES EXTENDED ALONG THE MAGNETIC FIELD. Grach, S. M.; Trakhtengerts, V. Yu. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1288-1296(1975). (In Russian)

The parametric instability of the magnetoactive plasma is investigated, both striction and thermal nonlinearities being taken into account. It is shown that when the ionospheric F-region is affected by a powerful short wave radiation, the aperiodic instability process associated with the thermal nonlinearity with the scale $l \sim 1/k_0$ has the lowest threshold. The parametric ion-cyclotron oscillations due to striction nonlinearity occur effectively with the smaller scales. (auth)

21079 RADIO WAVE PROPAGATION IN IONOSPHERIC WAVE CHANNELS. Erukhimov, L. M.; Matyugin, S. N.; Urya-

dov, V. P. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1297-1304(1975). (In Russian)

Various aspects of the problem of the influence of scattering and regular refraction on radio wave trapping by ionospheric wave channels (IWC) are considered. The role of inhomogeneities of polar and subpolar ionosphere on echo-signal transmission at different traces is discussed. Energy propagation losses due to scattering in IWC are estimated. (auth)

21080 SCATTERING EFFECT ON RADIO WAVE TRAPPING BY IONOSPHERIC WAVE CHANNELS. Gurevich, A. V.; Erukhimov, L. M.; Kim, V. Yu.; Uryadov, V. P.; Tsedilina, E. E. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1305-1316 (1975). (In Russian)

The problem of trapping of short radio waves radiated from the Earth due to scattering by ionospheric wave channels (IWC) has been considered. In Born approximation for Gaussian correlation function of the ionospheric electron density inhomogeneities an expression is obtained for the coefficient of trapping of a plane wave in IWC at the frequency f which are longer than MUF E and MUF F. It is shown that the most optimal size of inhomogeneities for trapping are $l \sim 50-100$ m and for the values of relative fluctuations of the electron density $\delta N \sim 10^{-3}$ the trapping coefficient $G \sim 10^{-3} + 10^{-4}$. Comparison with experimental data on receiving round-the-world signals indicates that the scattering effects in the ionosphere may at a considerable extent define the frequency band of round-the-world signals. (auth)

21081 RELATION BETWEEN STATISTICAL SW SIGNAL PARAMETERS IN VERTICAL AND OBLIQUE SOUNDING OF THE IONOSPHERE. Alimov, V. A.; Erukhimov, L. M.; Mironenko, L. F.; Skrebkova, L. A.; Rakhlin, A. V.; Uryadov, V. P.; Yurin, K. I. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1317-1322(1975). (In Russian)

Some results of the complex experiment on vertical (VS) and oblique sounding (OS) of the ionosphere are given. Statistical parameters with VS and OS of the ionosphere were equivalent only in a small number of sessions that was associated with time and spatial nonstationarity of ionosphere short wave scattering. The absence of definite regularities in frequency dependences of basic statistical SW signal parameters and the difference of signal statistic for ionospheric reflection from E and F region are shown. (auth)

21082 EXCITATION OF THE EARTH-IONOSPHERE WAVEGUIDE BY LOW-FREQUENCY IONOSPHERIC SOURCES. Bellyustin, N. S.; Dokuchaev, V. P.; Polyakov, S. V.; Tamoykin, V. V. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1323-1332(1975). (In Russian)

Electric and magnetic field perturbations in SLF and VLF ranges produced by a point source located in the ionosphere are considered. A plane model of the waveguide with a sharp boundary between the atmosphere and the ionospheric homogeneous magnetoactive plasma is accepted in calculations. Simple formulas have been obtained for the waveguide fields which permit the efficiency of different sources to be compared. (auth)

21083 PROPAGATION OF VERY LONG RADIO WAVES IN THE IONOSPHERE OF THE EARTH. I. Theory. Aksenov, V. I. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1333-1346(1975). (In Russian)

The solution of the problem of the field intensity of the baseground VLF-radiator in the spherical-stratified ionosphere is considered. Essential differences in the VLF field interference structure at the day and night ionosphere are clarified. The basic regularities of VLF propagation in the lower ionosphere are studied. An approximate method of calculating VLF transmission is suggested for the case of vertical incidence of a wave on the ionosphere. Its application reduces the computer time by an order. The influence of ion and electron density profile variations on VLF propagation through the lower ionosphere is analysed. The peculiarities of wave propagation in the upper ionosphere and magnetosphere are considered. It is established that the equation for the VLF trajectory at the heights up to 1000 km in the ionosphere may essentially differ from the appropriate equation in the magnetosphere. (auth)

21084 PROPAGATION OF VERY LONG RADIO WAVES IN THE IONOSPHERE OF THE EARTH. II. Results of the Experiments by Kosmos-142 and Kosmos-259. Aksenov, V. I. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1347-1354 (1975). (In Russian)

The results of experimental investigations of ionospheric radio wave propagation at 16.1, 31.85 and 42.85 kHz made by artificial satellites "Kosmos-142" and "Kosmos-259" are presented. Basic theoretical conclusions: the latitude cut-off phenomenon near the geomagnetic equator, an essential difference in the frequency dependence of the transmission coefficient and interference field structure in the ionosphere at the day and night-times, etc. are confirmed by the experiment. The dependence of the VLF field intensity in the ionosphere on the zenith angle of the Sun is discovered. The analysis showed that the middle latitude electron density at the heights up to 100-120 km increases 6-8 times as the zenith angle of the Sun changes from 60-70° to 30°. As a result of investigations of the magneto-conjugated VLF-signal characteristics (amplitude, group delay time etc.), VLF propagation in the magnetosphere occurs along higher-density ionization regions oriented by the geomagnetic field. (auth)

21085 SIGNAL STRUCTURE AT DIFFUSE REFLECTION FROM THE IONOSPHERE. Namazov, S. A. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1355-1364(1975). (In Russian)

The results of experimental investigation of the diffuse signal with 10 μc resolution at vertical and oblique sounding of the ionosphere in decameter wave range are presented. The role of different mechanisms of diffuse reflections is estimated. (auth)

21086 OPTIMUM CONDITIONS OF SHORT RADIO WAVE ULTRALONG PROPAGATION. Golyan, S. F. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1370-1382(1975). (In Russian)

The results of calculations and nomograms are given which permit a determination of the time moments (day and year) of occurrence of the optimal conditions for ultralong radio wave propagation up to round the world in any direction for any site on the earth. A comparison is made between the nomograms and the experiments on the ultralong propagation along various geographical paths. (auth)

21087 PROPAGATION OF ROUND-THE-WORLD AND BACKWARD ECHO-SIGNALS OUTSIDE THE PLANE OF A LARGE CIRCLE. Bubnov, V. A.; Rumyantsev, G. A. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1383-1386(1975). (In Russian)

The experimental data on propagation of backward echo-signals outside the plane of a large circle are presented. The influence of the horizontal ionospheric gradient, twilight zone and a large circle of the minimum ionospheric absorption on the effects observed is considered. (auth)

21088 SPECIFIC MEASURING UNIT OF KHARKOV POLYTECHNICAL INSTITUTE FOR IONOSPHERIC STUDIES BY INCOHERENT SCATTERING METHOD. Taran, V. I.; Rogozhkin, E. V.; Grigorenko, E. I.; Gridin, A. N.; Golovin, V. I.; Liokumovich, V. I.; Chernyaev, S. V. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1387-1388(1975). (In Russian)

A specific unit for measuring the ionospheric parameters (electron density, electron and ion temperatures, plasma drift velocity, etc.) by the incoherent scattering method is described. (auth)

21089 SEASONAL AND CYCLICAL VARIATIONS OF DISPERSION IN THE DIURNAL COURSE OF CRITICAL FREQUENCIES IN F REGION. Lilov, A.; Serafimov, K. B. (Geophysical Inst., Sofia). C. R. Acad. Bulg. Sci.; 28: No. 4, 473-476(1975).

The dispersion of the median values of critical frequencies in the F region is examined around their average monthly value. (BJG)

21090 PERIODICITIES IN IONIZATION STATE OF THE UPPER PART OF THE DAILY D REGION. Apostolov, E. M. (Geophysical Inst., Sofia). C. R. Acad. Bulg. Sci.; 28: No. 4, 465-467(1975).

The reflection of the period changes in the flow of ionizing radiation on the ionization state of the upper part of the D region is studied. X-rays are found to have a dominant role as an ionizing agent in the D region at high solar activity. (BJG)

21091 ROLE OF A SLIDING MECHANISM OF PROPAGATION IN EXCITATION OF IONOSPHERIC WAVEGUIDES. Sazhin, V. I.; Tinin, M. V. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1389-1393(1975). (In Russian)

The results of a numerical experiment indicating a significant role of sliding mechanisms of propagation in excitation of ionospheric waveguides responsible for a long propagation of short radio waves are presented. (auth)

21092 INFLUENCE OF IONOSPHERE POWERFUL HEATING ON SPORADIC E-REGION. Ignat'ev, Yu. A. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 9, 1365-1369(1975). (In Russian)

The influence of the ionospheric electron gas heating by powerful radiation on the sporadic E-region in the frame of the wind shift theory with taking into account the metal ion redistribution is investigated. Estimations of the change in the electron density in regular E- and E_s-regions are given for different degrees of

heating the electron gas by powerful radiation. It is shown that due to heating by the radio wave field the electron density in E_s-region decreases and its thickness increases. (auth)

21093 INTERACTION OF HIGH ENERGY MUONS IN ASSOCIATION WITH EAS, WITH ROCK AND LEAD. Chowdhuri, B.; Saxena, Y. C. (Physical Research Lab., Ahmedabad, India). Pramana; 5: No. 3, 162-173(Sep 1975).

An investigation on the interaction of high energy muons, associated with EAS and having energies greater than several hundred GeV, has been carried out at Kolar Gold Fields. A visual detector consisting of neon flash tube hodoscope has been used together with a scintillator detector to observe the muons and accompanying showers at the underground level. It has been found that nearly 90% of the showers observed at the underground level are generated in course of pure electromagnetic interactions of the muons with the matter traversed by them. The observed number of the showers is found to be consistent with the expected number calculated using the cross-sections for knock-on, bremsstrahlung and direct pair production processes. Rest of the observed showers do not appear to fit in the pure electromagnetic interaction scheme. Various possible production processes for these events have been discussed. Considering these events to be due to photo-nuclear interaction of muons in the rock, the observed number leads to a production cross-section σ_μ ($\gtrsim$ 25 Gev) $\lesssim (1 \cdot 6 \pm 0 \cdot 75)\ 10^{-29} cm^2$/nucl. (auth)

21094 ROCKET MEASUREMENTS OF CORPUSCULAR RADIATION AT VARIOUS GEOMAGNETIC LATITUDES. I. Apparatus for Corpuscular Radiation Studies Aboard MR-12 Meteorockets. Tulinov, V. F.; Feigin, V. M.; Zhuchenko, Yu. M.; Lipovetskii, V. A.; Novikov, L. S.; D'yachenko, V. A.; Babaev, A. P.; Zhuchenko, T. A. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 3, 321-325 (1975).

Translated from Kosm. Issled.; 13: No. 3, 361-366(1975).

A short description is offered of the experimental apparatus employed in the series of MR-12 meteorocket launchings, intended for investigation of the latitude distribution of corpuscular radiation. The equipment, including a soft corpuscular-radiation spectrometer using channel electron multipliers, a low-energy proton spectrometer using semiconductor detectors, and a system of gas-discharge Geiger counters provides information on the electron and proton spectra over the ranges 10^0–10^2 keV and 10^{-3}–10^2 MeV for electrons and protons, respectively. (auth)

21095 FLUX OF HIGH-ENERGY ELECTRONS AT ALTITUDES OF 200 TO 300 km ACCORDING TO DATA OF KOSMOS 264. Gal'per, A. M.; Iyudin, A. F.; Luchkov, B. I.; Ozerov, Yu. V.; Samoilenko, V. T. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 3, 394-396(1975).

Translated from Kosm. Issled.; 13: No. 3, 437-439(1975).

A spark-gamma telescope recording gamma quanta with energies $E_\gamma \geq 100$ MeV was operating in 1969 on the artificial Earth satellite Kosmos 264. Control of the spark chamber (SC) in the instrument was accomplished by a telescope of scintillation counters (C_1, C_2, C_3) and a directional Cerenkov counter. A convertor with a thickness of 1.0 rad. length Pb was located between C_1 and C_3. The total thickness of the SC electrodes was 3.7 rad. length Pb. The master pulse triggering the SC was $C_1C_3C_2Ch$. Events in the SC were recorded with a stereoscopic pair of objectives on 16-mm movie film. The geometrical factor of the instrument was 22.0 ± 2.2 $cm^2 \cdot sr$. The angle between the optical axis of the gamma telescope and the direction toward the zenith was 57° during the entire flight. The flight took place under magnetostatic conditions. (auth)

Magnetospheric Phenomena

Refer also to abstracts 20308, 21083, and 21084.

21096 CERTAIN CHARACTERISTICS OF THE SOLAR WIND, THE POSITION OF THE SHOCK WAVE, THE MAGNETOPAUSE, AND PLASMAPAUSE DURING THE PERIOD OF HIGH SOLAR ACTIVITY IN AUGUST 1972. Bezrukikh, V. V.; Gringauz, K. I.; Zastenker, G. N.; Khokhlov, M. Z. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 3, 304-312(1975).

Translated from Kosm. Issled.; 13: No. 3, 342-351(1975).

Results are presented of measurements of the parameters of the solar wind, the position of the near-Earth shock-wave front, and the magnetosphere and plasmasphere boundaries, which were performed by means of charged-particle traps carried by the "Prognoz" and "Prognoz-2" satellites. In accordance with the passage of shock waves from four solar flares which occurred on August 2-7, 1972, the parameters of the solar wind varied over wide limits (the concentration by more than two orders of magnitude, the temperature by more than one order of magnitude, and the velocity by at least a factor of three). The position of the magnetosphere boundary underwent abrupt changes—from significant contraction (to 6.3 R_E in the day sector) to significant expansion. A series of other features was observed—thus, the locations of the magnetopause and plasmapause practically coincided on August 8 at 10.25 UT at $L \approx 6.7$. (auth)

21097 PRELIMINARY RESULTS OF OBSERVATIONS OF RING-CURRENT PROTONS DURING MAGNETIC DISTURBANCES BY THE SATELLITE MOLNIYA-1. Grechin, A. N.; Kovrygina, L. M.; Kovtyukh, A. S.; Panasyuk, M. I.; Rubinshtein, I. A.; Sosnovets, E. N. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 3, 313-320(1975).

Translated from Kosm. Issled.; 13: No. 3, 352-360(1975).

This paper gives the results of experimental observations of the injection of ring-current protons ($30 < E_p < 380$ keV) into the radiation belt during the bay of October 28, 1973, and the three storms of January 25, February 12 and 21, 1974, with maximal D_{st} values of 65, 30 and 20 γ, respectively. During the main phases of the storms the proton ring current was asymmetric relative to the noon-midnight meridian. Particle injection was accompanied by changes in the shape of the spectrum on the inner edge of the ring current. The possible effect of ion-cyclotron instability on the formation of the inner edge of the ring current is examined. Immediately after the main phases of the storms on February 12 and 21, 1974, there was a dip in the spectrum in the pre-midnight sector at energies of several tens of keV. The formation of this dip could have been due to the development of instability leading to pitch-angle diffusion of protons and their loss in the region of the plasmapause. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 21115, 21132, 21214, and 21827.

21098 X-RAY EMISSION CROSS SECTIONS AND SPECTRAL DISTRIBUTIONS FOR CARBON BOMBARDED WITH MeV C, N, AND O IONS. Cacak, R.K.; Martin, F.W. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. A 13: No. 2, 599-608 (Feb 1976).

X rays emitted by a thin target bombarded with C, N, and O ions with energies between 1 and 2.5 MeV are observed at an angle of 135° with a Bragg crystal spectrometer having a resolution of 3 eV. The KL and KL^2 satellite lines of the carbon target are observed, as well as the diagram K line. These peaks are superimposed on a broad x-ray distribution extending from 265 to 290 eV. The KL^2 line appears for N at low energies, but not for C. Projectile and target spectra involve the K and KL lines in approximately equal amounts for C. These observations are interpreted as evidence for a molecular-orbital theory involving promotion of L electrons of the colliding atoms, in which the momentum change of the promoted electron is taken into account. Cross sections for production of carbon K x rays at energies below the carbon absorption edge in the Bragg pseudocrystal are obtained from the data. The cross sections rise monotonically with energy in the range studied and are smallest for oxygen ions, which have the largest atomic number. (auth)

21099 INFLUENCE OF THE ALTERED LAYER ON DEPTH PROFILING MEASUREMENTS. Winters, H.F.; Coburn, J.W. (IBM Research Laboratory, San Jose, California 95193). Appl. Phys. Lett. 28: No. 4, 176-179 (15 Feb 1976).

A simple phenomenological theory of alloy sputtering is developed which suggests that in some instances the depth resolution of depth profiling measurements is limited by the time it takes to create a layer of altered chemical composition at the surface. (auth)

21100 A HIGH-YIELD ION SOURCE FOR PRODUCING BEAMS OF H^+, H^+_3, He^+, Ne^+, Ar^+, Li^+, K^+, Na^+, AND Cd^+. Newton, G.; Unsworth, P.J. (University of Sussex, Brighton, Sussex, England). J. Appl. Phys. 47: No. 1, 70-73 (Jan 1976).

A high-yield radio-frequency ion source is described in which the ionization efficiency has been considerably enhanced by arranging for the radio-frequency oscillator to excite the lowest-order ($m=0$) helicon wave in the plasma. It has been used to produce intense beams of H^+, H^+_3, He^+, Ne^+, Ar^+, Li^+, K^+, Na^+, and Cd^+. A proton beam of up to 10 mA H^+ is attainable, with a proton fraction in excess of 96%, using only 300 W of excitation power. (auth)

21101 ENERGY REFLECTED FROM SOLID TARGETS BOMBARDED WITH keV PROTONS AND HELIUM IONS. Andersen, H.H. (Institute of Physics, University of Aarhus, DK-8000 Aarhus C, Denmark); Lenskjaer, T.; Sidenius, G.; Sørensen, H. J. Appl. Phys. 47: No. 1, 13-16 (Jan 1976).

The energy-reflection coefficient γ has been measured for keV protons impinging on Cu, Au, and Pb and helium impinging on Si, Ag, Ta, and Pb. The results are obtained by entirely independent techniques in three different laboratories. They agree within the stated accuracies of 10%. For a given projectile, γ is found to depend on the target material through the Thomas-Fermi reduced energy ϵ only. Hence, extrapolation to other target materials may easily be performed. The results are in good agreement with those obtained from recent computer simulations. (auth)

21102 A MAJOR ADVANCE IN HIGH-POWER ELECTRON-BEAM WELDING IN AIR. Lowry, J.F.; Fink, J.H.; Schumacher, B.W. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Appl. Phys. 47: No. 1, 95-106 (Jan 1976).

A major extension of the capabilities of nonvacuum electron-beam welding follows from the development of a machine with higher beam power. Tests with a new atmospheric electron gun operating at 60 kW have shown that the advantages of nonvacuum electron-beam welding must be reevaluated. Gas heating produced by the beam itself becomes very pronounced, so that electron scattering is reduced causing the high-power density of the beam to be retained over larger working distances. Single-pass butt welds with a depth-to-width ratio of 4 : 1 can be made in 3.8-cm-thick steel at a speed of 0.77 cm/sec, while the ultimate welding depth exceeds 5 cm. Medium thick material, e.g., 1.3-cm steel, can be welded at a 5-cm work distance, with a depth-to-width ratio of 3 : 1. The large work distance permits access to more complex structures and interior corners such at T sections, which can now be fabricated from a plate, 1.3 cm thick, at a speed of 2–3 cm/sec, making a full through weld from one side. Also, seam welds of two 3-mm-thick hot-rolled steel sheets can be produced at speeds of up to 15 cm/sec. High-power machines need not be significantly larger or costlier than low-power guns, and the present 60 kW does not represent any technical limit. Welding efficiency improves with higher power; when welding steel of 2 cm thickness or more the energy efficiency of the process at 60 kW is better than 50%, while at 40 kW it is merely 30%. In addition, the high power permits greater welding speed. These developments translate directly into improved cost justification for electron-beam welding and a broad expansion of its possible applications. (auth)

21103 PRODUCTION OF INTENSE PROTON FLUXES IN A MAGNETICALLY INSULATED DIODE. Dreike, P.; Eichenberger, C.; Humphries, S.; Sudan, R. (Laboratory of Plasma Studies, Cornell University, Upson Hall, Ithaca, New York 14850). J. Appl. Phys. 47: No. 1, 85-87 (Jan 1976).

A magnetically insulated diode has been used to produce intense fluxes of protons with high efficiency. Currents in excess of 4 kA with current density greater than 50 A/cm^2 have been produced in a 50-nsec bursts at energies up to 200 keV. The system appears to be easily scalable to higher parameters. The extraction of the beams, as well as geometries in which current densities of kA/cm^2 may be realized, are discussed. (auth)

21104 HELIUM DIFFRACTION FROM TUNGSTEN (112). Stoll, A.G. Jr.; Ehrhardt, J.; Merrill, R.P. (Department of Chemical Engineering, University of California, Berkeley, California 94720). J. Chem. Phys. 64: No. 1, 34-40 (1 Jan 1976).

The diffractive scattering of helium from W(112) in the [1$\bar{1}$0] azimuth is presented for incidence angles from 20° to 70°, surface temperatures from 1000 to 1600 K, and beam temperatures from 300 to 650 K. The first order beams are the only nonspecular features observed and their angular positions and relative intensities are reproduced well by semiclassical scattering calculations. Debye–Waller analysis of thermal attenuation gives a surface Debye temperature lower than the bulk, but larger than that derived from electron scattering. (auth)

21105 SCATTERING OF ARGON AND NEON FROM W(112). White, R.E.; Ehrhardt, J.; Merrill, R.P. (Department of Chemical Engineering, University of California, Berkeley, California 94720). J. Chem. Phys. 64: No. 1, 41-44 (1 Jan 1976).

The angular scattering distributions of thermal Ne and Ar beams incident in the [1$\bar{1}$0] azimuth of the W(112) surface are presented as a function of angle of incidence, surface temperature, and beam temperature. For Ne, the distributions are rainbow patterns similar to those observed for Ne on LiF for small angles of incidence. They coalesce into a broad lobe at an incidence angle of 70°. Argon scattering is unilobular and similar in all details with Ar scattering from the smoother W(110) surface. Ne appears to be in the inelastic regime while Ar is trapping dominated. (auth)

21106 A SEMICLASSICAL MODEL FOR ATOMIC SCATTERING FROM SOLID SURFACES–He AND Ne SCATTERING FROM W(112). Masel, R.I.; Merrill, R.P. (Department of Chemical Engineering, University of California, Berkeley, California 94720); Miller, W.H. J. Chem. Phys. 64: No. 1, 45-56 (1 Jan 1976).

A semiclassical formalism is presented which predicts specular atomic scattering from close-packed surfaces and either "rainbow" or diffractive scattering from strongly periodic surfaces. The intensities are a series of δ functions at the Laue conditions modulated by the product of the classical intensities and a structure factor accounting for interference among multiple trajectories within a unit cell. Narrow energy distributions in the incident beam and/or long wavelengths result in well-resolved diffracted beams, while broad distributions and/or small wavelengths result in coalesced beams which display only the "rainbowlike" intensity envelope. A simple elastic model using a 6–9 potential has been used to predict He and Ne scattering from W(112). For helium the peak positions and relative peak heights agree with the measured scattering essentially within experimental reproducibility, but the peak widths calculated with this elastic model are too narrow and the intensity maxima too large. Neon calculations reproduce qualitatively the rainbow patterns observed in the experiments but neither the intensities nor the positions of the rainbow features are correct, indicating the existence of large inelastic effects. (auth)

21107 BREMSSTRAHLUNG INDUCED BY PROTON AND ^{3}He-ION BOMBARDMENTS IN THE 1–4-MeV/amu ENERGY RANGE. Ishii, K.; Morita, S. (Department of Physics, Tohoku University, Sendai, Japan); Tawara, H. Phys. Rev. A 13: No. 1, 131-138 (Jan 1976).

Continuous x rays from a thin aluminum target produced by proton and ^{3}He-ion bombardments have been measured with a Si(Li) detector over the impact-energy ranges 1–4 MeV and 3–9 MeV, respectively. The experimental results obtained were compared with theoretical predictions based on the binary-encounter approximation. Agreements are obtained both in the shape of spectra and absolute cross sections without any

adjustable parameter over the entire energy range measured, but generally the theoretical calculation predicts smaller cross sections than the experimental results as the photon energy becomes higher and the bombarding energy gets lower. Energy-dependent directional anisotropy of the bremsstrahlung was theoretically estimated and compared with the experimental results measured at directions 45°, 90°, and 135° with respect to the incident beam, showing qualitative agreement. (auth)

21108 NEW LASER-INDUCED FLUORESCENCE METHOD FOR MOLECULAR BEAM VELOCITY ANALYSIS. Gaily, T.D.; Rosner, S.D.; Holt, R.A. (Department of Physics, University of Western Ontario, London, Ontario N6A 3K7, Canada). Rev. Sci. Instrum. 47: No. 1, 143-145 (Jan 1976).

We have measured the velocity distribution of a Na_2 supersonic beam by a time of flight method in which a chopped beam from an argon ion laser depopulates a single vibration–rotation level of the Na_2 ground electronic state, and a continuous laser beam further downstream is used to detect the arrival of the tagged molecules by observation of changes in the laser-induced fluorescence. (auth)

21109 NEW CROSSED-BEAM APPARATUS FOR THE STUDY OF ION–MOLECULE COLLISION PROCESSES. Vestal, M.L.; Blakley, C.R.; Ryan, P.W.; Futrell, J.H. (Department of Chemistry, University of Utah, Salt Lake City, Utah 84112). Rev. Sci. Instrum. 47: No. 1, 15-26 (Jan 1976).

A new crossed-beam apparatus for the study of ion–molecule collision processes is described. Among the novel features of this apparatus are a high pressure "chemical ionization" ion source, an apertureless exponential ion deceleration lens, a product ion mass/energy analyzer that can be scanned in angle through nearly a full octant of a sphere, and a supersonic nozzle molecular beam source. The high pressure source can be used to produce vibrationally relaxed ground state reactant ions, and the deceleration lens produces focused ion beams with energies as low as 0.1 eV at intensities equal to the space-charge limit. (auth)

21110 ELECTRON-BOMBARDMENT ION SOURCES. Reader, P. D.; Kaufman, H. R. (to Ion Tech, Inc.). US Patent 3,913,320. 21 Oct 1975. Filed date 13 Nov 1974. 10 p.

An electron-bombardment ion source includes a chamber into which a propellant is introduced. The propellant is ionized by means of electrons drawn toward an anode from a cathode. At one end of the chamber is an apertured screen followed by an aligned apertured grid. The grid is maintained at a potential that accelerates the ions out of the chamber through the screen and the grid. A surface within the chamber, such as the screen, the wall of the chamber or both, and other than the anode and cathode, is maintained at a potential approaching the anode during the initiation of ion production, while being maintained at a potential approaching that on the cathode during steady-state ion production. Conveniently, this is achieved by interposing a resistance, of appropriate value, between that surface and a potential source. (auth)

21111 CAVITY IEMP ENHANCEMENT BY DIELECTRIC WALLS. Littel, R. G.; Uglum, J. R.; Lowell, R. A. (Simulation Physics, Inc., Burlington, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2351-2355(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The presence of dielectric surfaces within evacuated (10^{-4} torr) cavities can significantly enhance the transport of electron beams through the cavity. Under situations in which the beam would normally be strongly space charge limited, current enhancement by factors greater than ten has been observed. A review is given of a program which studies the parametric dependence of this effect on dielectric thickness and geometry and a model is presented for its explanation. (auth)

21112 INTERATOMIC POTENTIAL AND ENERGY LOSS IN PLANAR CHANNELLING. Pathak, A. P. (CEN, Fontenay-aux-Roses, France). J. Phys., C (London); 8: No. 21, L439-L444 (7 Nov 1975).

An interatomic potential, essentially a mathematical approximation to Lindhard's standard interatomic potential but simpler to use, has been examined with regard to its predictions for the variation of the stopping function with the position of the ion in the channel. The variation of the interatomic potential itself with interatomic distance is found to be close to that of Lindhard's potential as well as the Moliere potential, for all values of r greater than a, the Thomas–Fermi distance. The variation of the stopping function for heavy-ion ($^{127}_{53}I$) and α-particle channelling in the {100} and {111} planes of gold single crystals for the new (and simpler) potential is found to be reasonably close to the predictions of the Lindhard and Moliere potentials. (auth)

21113 HIGH DENSITY MOLECULAR BEAM PRODUCED BY A MULTICHANNEL NOZZLE. Nguyen, B.; Bennani, A. L.; Rouault, M. (Paris Univ., Orsay, France). J. Phys., E (London); 8: No. 11, 909-912(Nov 1975). (In French).

A comparative study of gaseous beams used as targets in collision experiments is presented for two different kinds of nozzles. The angular spread of the beam at the nozzle output and the density distribution along the beam axis were measured using an electron diffraction method. The second step was to show the formation of clusters in the beam by increasing the pushing pressure. This was done by a measurement of the differential elastic cross section as a function of the scattering angle. The results show a better spatial localization and a higher density of the beam when obtained by the multichannel nozzle. Also the cluster formation in such a beam is less probable than in a free expansion beam. (auth)

Atomic and Molecular Properties

Refer also to abstracts 19856, 20069, 20096, 21104, 21106, 21165–21167, 21178, 21204, 21228, 21246, 21251, 21260, 21812, and 21878.

21114 ISOTOPIC DIFFERENCES IN THE BRIGHTNESS OF HYDROGEN ATOMIC LINES. Nemets, V.N.; Orlova, N.M.; Petrov, A.A. Opt. Spectrosc. (USSR) 39: No. 3, 242-244 (Sept 1975).

Isotopic differences in the brightness of hydrogen atomic lines were observed in a high-frequency electrodeless discharge. The influence of the discharge conditions (pressure and the degree of dilution of the hydrogen-deuterium mixture by third components) on the magnitude of this difference was shown. A physical model was developed based on the investigation of dissociative-recombination-exchange processes responsible for the formation of the concentration of neutral atoms of isotopes in the discharge. It enabled us to explain and calculate quantitatively the observed regularities. (auth)

21115 EQUILIBRIUM CHARGE-STATE DISTRIBUTIONS OF HEAVY-ION BEAMS AFTER PASSAGE THROUGH CARBON FOILS. Heinemeier, J.; Hvelplund, P.; Oestgaard Olsen, J.; Simpson, F. P. (Aarhus Univ., Denmark). Phys. Scr.; 10: No. 6, 304-306(Dec 1974).

Equilibrium charge distributions have been measured for beams of ^{59}Pr, ^{64}Gd, ^{71}Lu, ^{80}Hg, ^{81}Tl and ^{82}Pb ions, which were sent through thin carbon foils (~4 $\mu g/cm^2$) at beam energies ranging from 300 keV to 1000 keV. Corrections were made for energy loss in the carbon foils, partly by means of direct measurements and partly by means of theoretical electronic and nuclear-stopping cross sections for the forward-directed beam. The main purpose of the present work has been to extend existing data on equilibrium charge-state fractions. Similarities in the measured equilibrium charge-state distributions for the rare earths Pr, Gd, and Lu, and also the fact that only a weak shell effect around Hg was found, suggest that the charge distributions of one heavy atom could be used for neighboring atoms (or group of atoms) within the same period. (auth)

21116 APPLICATION OF THE FINITE-DIFFERENCE BOUNDARY VALUE METHOD TO THE CALCULATION OF Born–Oppenheimer VIBRATIONAL EIGENENERGIES FOR THE DOUBLE-MINIMUM $E,F\ ^1\Sigma^+_g$ STATE OF THE HYDROGEN MOLECULE. Truhlar, D.G.; Tarara, W.D. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). J. Chem. Phys. 64: No. 1, 237-241 (1 Jan 1976).

The finite-difference boundary value method is applied to the calculation of Born–Oppenheimer vibrational energies and expectation values of R^{-2} for an excited state of H_2. We estimate the accuracy attainable by this method, point out a systematic error in the previous calculations of Tobin and Hinze, and correct several unjustified statements in the literature. Finally we point out that there is a large uncertainty in the final results due to choice of interpolation scheme. (auth)

21117 AN EFFECTIVE SCHRÖDINGER EQUATION FOR THE ROVIBRONIC ENERGIES OF H_2 AND D_2. Bishop, D.M.; Shih, S. (Department of Chemistry, University of Ottawa, Ottawa, Canada K1N 6N5). J. Chem. Phys. 64: No. 1, 162-169 (1 Jan 1976).

A new effective Schrödinger equation for the calculation of the rovibronic energies of H_2 and D_2 is proposed. The equation takes into account nonadiabatic effects and it is used to calculate the nonadiabatic corrections to the adiabatic vibronic energies. The root-mean-square deviation of the corrections from the experimentally derived ones is less than the accuracy of the experimental vibronic energies and smaller than the deviation of the corrections calculated by alternative methods. (auth)

21118 SPLINE BASES FOR ATOMIC CALCULATIONS. Altenberger-Siczek, A.; Gilbert, T.L. (Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 64: No. 1, 432-433 (1 Jan 1976).

The use of spline bases has been proposed for *ab initio* electronic structure calculations. They offer the apparent advantage that no

nonlinear parameters occur, so that exponent optimization is unnecessary, and the number of two-electron integrals in SCF calculations increases only as n^2 rather than n^4 where n is the number of basis functions. The results of test calculations on the helium atom are reported in this note. Analysis of the computer time required to achieve accuracy comparable to other methods indicates that spline bases are not suitable for SCF calculations. (AIP)

21119 LOCALIZED ORBITALS AND SHORT-RANGE MOLECULAR INTERACTIONS. IV. NONADDITIVITY IN QUARTET AND QUINTET STATES OF HYDROGEN ATOMS. Magnasco, V.; Musso, G.F.; Figari, G. (Istituto di Chimica Industriale dell'Università, 16132 Genova, Italy). J. Chem. Phys. 64: No. 1, 120-123 (1 Jan 1976).

The separation of the short-range interaction energy into Coulombic and penetration components introduced in Paper I of this series is extended to open-shell systems of maximum spin multiplicity. *Ab initio* calculations with a minimal set of 1s Slater orbitals are reported for the quartet state of H_3 (isosceles triangles) and for the quintet states of tetrahedral and square H_4. Nonadditivity of short-range interactions is seen to arise from the penetration of nonorthogonal localized open-shell orbitals into the core provided by nuclei and unperturbed electrons of all other groups, a result already found for closed shells. The validity of representing nonadditive effects in terms of powers of the overlap integrals is shortly discussed. (auth)

21120 TEMPERATURE DEPENDENCE OF HYPERFINE DENSITY SHIFTS. IV. ^{23}Na, ^{39}K, AND ^{85}Rb IN He, Ne, Ar, AND N_2 AT LOW TEMPERATURES. Bean, B.L.; Lambert, R.H. (University of New Hampshire, Durham, New Hampshire 03824). Phys. Rev. A 13: No. 1, 492-494 (Jan 1976).

Measurements of the temperature dependence of the hyperfine density shifts of ^{23}Na, ^{39}K, and ^{85}Rb in He, Ne, Ar, and N_2 buffer gases have been extended to low temperatures (−125 to 25° C). The results confirm and extend the nonlinear temperature dependence. Low-order polynomial fits of the density shifts vs T (°C) have been calculated for each alkali metal and buffer gas. (auth)

21121 ON THE HYPERFINE SPLITTING OF THE HYDROGEN ATOM IN A SPHERICAL BOX. Suryanarayana, D.; Weil, J.A. (Department of Chemistry and Chemical Engineering, University of Saskatchewan, Saskatoon, Canada S7N 0W0). J. Chem. Phys. 64: No. 2, 510-513 (15 Jan 1976).

The hyperfine splitting of the hydrogenlike atom confined to a sphere of radius r_0 is examined as a function of r_0. The wavefunction is made to vanish at $r=r_0$ and is normalized to unity over the finite sphere. The effect of decreasing r_0 (i.e., compressing the sphere isotropically) on the hyperfine splitting A of the ground state is nonlinear, with A increasing approximately as r_0^{-1}. Comparison with atomic hydrogen trapped in α-quartz is made. (auth)

21122 PHOTOABSORPTION CROSS SECTIONS OF TWO-ELECTRON ATOMS BY THE COORDINATE ROTATION METHOD: APPLICATION TO H^- AND SEVERAL STATES OF HE. Rescigno, T.N.; McCurdy, C.W. Jr.; McKoy, V. (A. A. Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). J. Chem. Phys. 64: No. 2, 477-480 (15 Jan 1976).

The coordinate rotation method, recently extended by us to treat photoabsorption processes, is used to obtain photoabsorption cross sections for several two-electron atoms. The calculations are performed using standard configuration-interaction methods; the need for atomic continuum wavefunctions is completely avoided in this approach. We have computed the photodetachment cross section of H^- and photoionization cross sections for He in its ground and $2\,^1S$ states. In all cases, the computed cross sections agree well with results obtained by numerical integration and with available experimental data. (auth)

21123 $4s^24p^6$–$4s4p^5$ TRANSITIONS IN FIVE-TIMES-IONIZED YTTRIUM (Y VI). Zalubas, R.; Reader, J.; Corliss, C.H. (National Bureau of Standards, Washington, D.C. 20234). J. Opt. Soc. Am. 66: No. 1, 35-36 (Jan 1976).

The spectrum of yttrium has been observed in a sliding spark discharge at peak currents up to 2000 A on the 10.7 m normal and grazing incidence vacuum spectrographs at NBS. From these observations, the group of $4s^24p^6$–$4s4p^5$ transitions in Y VI, which lie in the region 457–766 Å, has been identified and measured, thus yielding values for the 4 levels of the $4s4p^5$ configuration and revised values for the 5 levels of the $4s^24p^4$ configuration. The energy parameters obtained from a least-squares fit to the observed levels are compared with Hartree-Fock calculations. (auth)

21124 VIBRATIONAL RELAXATION TIMES OF F_2 WITH Ar AND He AND H_2 AND D_2 WITH He. Cady, W.A.; Diebold, A.C. (Department of Chemistry, Indiana-Purdue University at Indianapolis, Indianapolis, Indiana 46205). J. Chem. Phys. 64: No. 2, 686-688 (15 Jan 1976).

The vibrational relaxation times for F_2 in Ar and He and for H_2 and D_2 in He are calculated and compared with the data from shock tube experiments. The near-adiabatic approximation developed previously [J. Chem. Phys. 61, 1214 (1974)] was employed to calculate the relaxation times. A comparison of these results with those from the SSH theory, which contain a "static" approximation, shows the current theory to be as accurate or more accurate than the SSH theory except for the systems dominated by impulsive collisions. Calculations treating transitions in addition to the 1 to 0 transition were also performed and discussed. (auth)

21125 CHARGE CLOUD STUDY OF ATOMIC AND MOLECULAR STRUCTURE. Rioux, F. (Department of Chemistry, St. John's University, Collegeville, Minnesota 56321); Kroger, P. Am. J. Phys. 44: No. 1, 56-59 (Jan 1976).

The conceptually simple charge cloud model of atomic and molecular structure is applied to three problems: atomic hydrogen, molecular hydrogen, and crystalline lithium hydride. Because of its simplicity, the model lends itself well to calculations that are easily performed by undergraduates. While the calculations are, on the whole, only in modest agreement with experimental results, the model provides useful insights in all the areas to which it is applied. (auth)

21126 URANIUM EXCITED-STATE PARAMETERS. Maceda, L.; Bathke, C. G.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 153-155(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21127 CALCULATIONS AND MEASUREMENTS OF THE DYNAMIC STARK EFFECT IN HYDROGEN. Rutgers, W. R.; Kalfsbeek, H. W. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Z. Naturforsch., A; 30: 739-749(1975).

A theory is given for the spectral profile of the first hydrogen Balmer line when the radiating neutral atom is under influence of both (quasi-) static and harmonically oscillating electric fields. Profiles, measured in a turbulent heating experiment, show a series of intensity maxima on the wings of the Balmer lines. If we assume a model for the spatial distribution of turbulent wave vectors, we can derive the fieldstrength and the direction of low-frequency (ion-acoustic) oscillations and the strength and frequency of high-frequency (Langmuir) oscillations. (12 figs) (auth)

21128 RELATIVISTIC EFFECTS ON LINE STRENGTHS FOR TRANSITIONS IN THE HYDROGENIC ISOELECTRONIC SEQUENCE. Younger, S. M.; Weiss, A. W. (National Bureau of Standards, Washington, DC). J. Res. Natl. Bur. Stand.; 79A: No. 5, 629-633(1975).

Relativistic line strengths have been computed for a large number of transitions using Dirac wave functions for the one-electron, hydrogen-like ions. As expected, the results indicate that relativistic effects are quite small for low stages of ionization. However, in general, they also remain small throughout a large portion of the isoelectronic sequence, becoming typically of the order of 10 percent in the vicinity of Z equals 50, after which they grow quite rapidly. This suggests that for multielectron ions a basically nonrelativistic theory might well be adequate for light atom isoelectronic ions through as much as 30 or 40 stages of ionization. (auth)

21129 HARTREE–FOCK COMPTON PROFILES FOR THE ELEMENTS. Biggs, F. (Sandia Labs., Albuquerque, NM); Mendelsohn, L. B.; Mann, J. B. At. Data Nucl. Data Tables; 16: No. 3, 201-309(Sep 1975).

Orbital and total-atom Compton profiles are given for the elements. Hartree-Fock wavefunctions were used in the numerical calculations for atomic numbers 1 less than or equal to Z less than or equal to 36 and relativistic Dirac–Hartree–Fock wavefunctions for atomic numbers 36 less than or equal to Z less than or equal to 102.

21130 ABSORPTION SPECTRUM OF UF_6 FROM 2000 TO 4200 A. DePoorter, G. L.; Rofer-DePoorter, C. K. (Los Alamos Scientific Lab., NM). Spectrosc. Lett.; 8: No. 8, 521-524(1975).

A spectrum of UF_6 between 2000 and 4200 A that shows significant structure below 3400 A is presented. The absorption in this region must be observed at very low pressures and relatively short path lengths. (JFP)

21131 RADIATIVE TRANSITIONS AND COHERENT SCATTERING OF LIGHT IN HELIUM AND HELIUM-LIKE ATOMS. Lin, C. P. Notre Dame, IN; Univ. of Notre Dame (1975). 153p. University Microfilms Order No. 75-18,718.

Thesis (Ph. D.).

Some quantum electrodynamic studies of helium and helium-like atoms are presented. Two elementary processes, the 2^3S_1 yields 1^1S_0 transition and Rayleigh scattering, are considered. The calcu-

lations are based on the Furry bound interaction representation of quantum electrodynamics and expansion in powers of alpha Z is avoided. The basic one-electron states are constructed from solutions to the Dirac equation including the ground state Dirac–Hartree–Fock (DHF) potential. Correlation and transverse-photon-exchange effects are included in the calculation by the perturbation expansion of the S-matrix in powers of alpha. (Diss. Abstr. Int., B)

21132 NON-ADIABATIC SPIN TRANSITIONS IN METASTABLE HYDROGEN. Hight, R. D. Bozeman, MT; Montana State Univ. (1975). 222p. University Microfilms Order No. 75-25,755.

Thesis (Ph. D.).

The problem of non-adiabatic passage of an oriented spin through an inhomogeneous magnetic field is considered. Differential equations for the spin state amplitudes for an arbitrary magnetic field are derived for the two cases of spin ½ and spin 1. The field is shown to be completely characterized by a single parameter called the adiabaticity parameter alpha. The adiabaticity parameter is the ratio of the field magnitude to the field rotation rate. By means of a pedagogical example, a criterion for defining regions of adiabaticity (no spin flips) and nonadiabaticity (spin flips) is developed. Using this criterion, the transition length for regions where transitions occur is defined. The amplitude equations for a simple type of magnetic field are solved and the spin flip probability is calculated. The field is assumed constant everywhere except in a small region where the axial component goes linearly through zero, reversing its direction. A magnetic field that closely approximates the above field was constructed. By using the F equals 1 hyperfine states in the 2S/sub ½/ level of atomic hydrogen, the theory is confirmed by comparison with experiment. A novel method of producing a beam of metastable (2S/sub ½/) atomic hydrogen polarized completely in the F equals 1, m/sub F/ equals 0 hyperfine state is proposed. (Diss. Abstr. Int., B)

21133 RADIATIVE AND NON-RADIATIVE TRANSITIONS OF Eu^{3+} IN BINARY SOLVENT SYSTEMS. Chrysochoos, J. (Univ. of Toledo). Spectrosc. Lett.; 8: No. 10, 771-786(1975).

Results obtained in spectroscopic studies of Eu^{3+} in binary solvent systems in which only one of the components is the solvating species are reported. Solutions of $EuCl_3$ and/or $Eu(NO_3)_3$ in CH_3COOH-CCl_4 or CH_3COOH-$CHCl_3$ were used. Fluorescence yields of Eu^{3+} in CH_3COOH were measured. (GHT)

21134 ANGULARLY PROJECTED HARTREE–FOCK CALCULATION OF THE HYPERFINE INTERACTION IN Li 2^2P. Laskowski, B. (Rijksuniversitair Centrum, Antwerp); Lunell, S. Int. J. Quant. Chem., Symp.; No. 9, 175-182(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Projected Hartree–Fock calculations involving both spin and orbital angular momentum projection are reported for the lowest ^2P state of Li. The value 0.0679 a.u. is obtained for the spin-dipolar hyperfine structure term, in very good agreement with the experimental result of 0.0690 a.u. The energy is -7.36516 a.u. compared to the Hartree–Fock result of -7.36507 and the experimental energy of -7.41016 a.u. (auth)

21135 STEPWISE EXCITATION AND LEVEL CROSSING SPECTROSCOPY OF THE TRIPLET D STATES OF ^{4}He. Tam, A. C. New York; Columbia Univ. (1975). 127p. University Microfilms Order No. 75-18,445.

Thesis (Ph. D.).

The fine structure intervals of the lowest two triplet D states of ^{4}He have been obtained by a new method: ground state atoms are excited by a discharge to the triplet metastable state, which then undergoes a two-step optical excitation to the triplet D states, where level crossing spectroscopy is made. The experimental results are given. These values are much more precise than the previously available data, obtained by optical, particle-bombardment level crossing, or beam-foil quantum beat spectroscopy, and are consistent with the previous data except for one case, where a previous measurement of 3^3D_2–3^3D_3 by electron bombardment level crossing spectroscopy is believed to be in error. The experimental values for the fine structures of the triplet D states of ^{4}He clearly indicate the inadequateness of existing theoretical calculations on these fine structures and related properties of helium. (Diss. Abstr. Int., B)

21136 APPLICATIONS OF ANALYTIC CONTINUATION IN THE CONSTRUCTION OF POTENTIAL ENERGY CURVES. Jordan, K. D. (Yale Univ., New Haven). Int. J. Quant. Chem., Symp.; No. 9, 325-336(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The representation of potential energy curves by continued fractions is investigated and shown to be a useful method in the extrapolation of data. A generalization of the method is presented that enables one to treat avoided crossing problems. Given data on one curve involved in the avoided crossing, it is possible to obtain a good approximation to the other. Results for various model calculations and for the H_2 (E,F^1SIGMA^+/sub g/) and CO ($^1SIGMA^+$) potential curves are presented. (auth)

21137 VIBRATION–ROTATION ANALYSIS OF SOME NON-LINEAR MOLECULES BY A VARIATIONAL METHOD. Carney, G. D. (Battelle Columbus Labs., OH); Kern, C. W. Int. J. Quant. Chem., Symp.; No. 9, 317-323(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A variational method is used to obtain vibration–rotation energies from potential functions which were derived by inverting observed band origins via perturbation theory. For the molecules SO_2, NO_2, ClO_2, H_2S, O_3, H_2O, D_2O, and HDO significant discrepancies with experiment which can be accounted for by truncation errors in the perturbation expansion are found. (auth)

21138 OPTIMAL EVEN-TEMPERED GAUSSIAN ATOMIC ORBITAL BASES: FIRST-ROW ATOMS. Raffenetti, R. C. (National Aeronautics and Space Administration, Hampton, VA). Int. J. Quant. Chem., Symp.; No. 9, 289-295(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Atomic Hartree–Fock self-consistent-field energy-optimized even-tempered Gaussian bases are obtained for hydrogen, helium and all first-row atoms in their ground states. In comparison with Huzinaga-type bases the present energies are found to form somewhat weaker upper bounds. The utilization of the even-tempered Gaussian atomic orbital bases in molecular calculations is discussed with regard to their special capabilities. (auth)

21139 IONIZATION WITH EXCITATION OR REMOVAL OF SEVERAL ELECTRONS. Chibisov, M. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 38: No. 2, 130-133(Feb 1975).

Translated from Opt. Spektrosk.; 38: No. 2, 236-243(Feb 1975).

The sudden perturbation approximation has been used to calculate the limiting (for high speed collisions) probabilities for ionization with the removal of one electron and the simultaneous excitation of a second electron in the two electron systems H^-, He, Li^+, etc. up to Z = 18. Ground state wave functions for these atoms took into account only the radial correlations. The Chandrasekhar functions also took angular correlation into consideration. The calculated probabilities were compared with the results of experimental studies and the findings of other computations. (auth)

21140 Sc L X-RAY EMISSION FROM METAL AND Sc_2O_3. Utriainen, J.; Valjakka, J.; Linkoaho, M. (Helsinki Univ. of Tech., Otaniemi, Finland). J. Phys., C (London); 8: No. 21, 3710-3714 (7 Nov 1975).

Scandium L x-ray emission spectra from the metal and the oxide (Sc_2O_3) have been studied with a grating spectrometer. The weak L_1 emission line $L\beta_{3,4}$ was observed for the first time in Sc. In the metal, the measured linewidth was 4.5 ± 1 eV. The observed intensity ratio I(Lη)/I(Ll) was about 0.2 both in the metal and the oxide and thus deviates from the statistical value of 0.5. Evidence is presented to show that the broad emission band on the low-energy side of the L1 line is due to radiative Auger transitions. (auth)

21141 MEASUREMENT OF THE FINE-STRUCTURE INTERVALS S-D AND S-F IN He^+, n = 5. Beyer, H. J.; Kleinpoppen, H. (Stirling Univ., Eng.). J. Phys., B (London); 8: No. 15, 2449-2455 (21 Oct 1975).

Electric-field-induced higher-order anticrossing signals have been used to measure the fine-structure separations S-D and S-F in n = 5 of He^+. The results are (10309.8 ± 14.6) MHz for the interval $5^2S_{½}$-$5^2D_{½}$, (14055.4 ± 12.6) MHz for $5^2S_{½}$-$5^2D_{⅝}$, (14058.2 ± 13.6) MHz for $5^2S_{½}$-$5^2F_{⅝}$, and (15924.5 ± 10.7) MHz for $5^2S_{½}$-$5^2F_{⅞}$. (auth)

21142 RELATIVISTIC EFFECTS IN THE IMPACT-PARAMETER DEPENDENCE OF K-SHELL IONIZATION OF HEAVY ELEMENTS. Clark, D. L.; Li, T. K.; Moss, J. M.; Greenlees, G. W.; Cage, M. E.; Broadhurst, J. H. (Univ of Minnesota, Minneapolis). J. Phys., B (London); 8: No. 15, L378-L381(21 Oct 1975).

The impact-parameter dependence of K-vacancy production in Ta, Au, Bi, and U by 4 MeV protons has been measured using a magnetic spectrometer and fast coincidence techniques. The ionization probabilities are greater than non-relativistic SCA predictions by as much as a factor of four. The inclusion of relativistic electronic wavefunctions in the SCA calculations substantially reduces the discrepancies. (auth)

21143 NON-ORTHOGONAL ORBITALS AND PERTURBATION THEORY. Killingbeck, J. (Hull Univ., Eng.). J. Phys., B (London); 8: No. 10, 1585-1590(11 Jul 1975).

A simple perturbation procedure is described, using two non-orthogonal functions chosen so as to automatically diagonalize the operator $(H_0 - E_0)$. The method yields good results for the second-order energy contributions $E_2(1)$ to the $1s^2$ ground state energy. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstract 21724.

21144 CHEMICAL EFFECTS IN NEGATIVE MUON CAPTURE IN SOME IONIC AND COVALENT SOLIDS AND IONIC AQUEOUS SOLUTIONS. Knight, J.D.; Orth, C.J.; Schillaci, M.E. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545); Naumann, R.A.; Daniel, H.; Springer, K.; Knowles, H.B. Phys. Rev. A 13: No. 1, 43-53 (Jan 1976).

Muonic x-ray spectra have been measured for target sequences including graphite, diamond, their boron-nitride counterparts, three organic compounds, ice and water, eight oxides of metals, alkali halides in aqueous solution and alkali chlorides in anhydrous crystalline form, and calcium and titanium hydrides. Comparisons are made of Lyman-series intensity patterns, and relative muon capture probabilities in the constituent elements of compounds are compared with "Z-law" relation. The Lyman intensities of the C and N in the low-Z targets are found to exhibit two kinds of pattern, one with relatively weak higher-series members characterizing the diamond and graphite structures, and one with stronger higher-series members characterzing the other (hydrogen-containing) compounds. There is some evidence that the latter intensity behavior applies to the aqueous ions as well. For the oxide sequence, increasing covalency appears to correlate with increasing muon capturing ability of the metal element and with increasing intensity of the higher Lyman members for both the metal element and the oxygen. Effective relative muon-capture cross sections have been obtained for aqueous alkali and halide ions. (auth)

21145 COHERENT RADIATIVE TRANSITIONS IN MESIC-ATOMS. Tansey, R. J. Lowell, MA; Lowell Technological Inst. (1975). 164p. University Microfilms Order No. 75-26,385.

Thesis (Ph. D.).

Line shapes, line widths, and the ratio of intensities in the cascade of mesic-atoms are calculated by two methods. In the first, or standard approach, each photon emission is considered as an independent event. The energy of the photons being given by the energy difference between the two levels (plus the width of the initial and final states). In the second method, the photons are assumed to be emitted simultaneously from all levels of the cascade. This coherent approach differs from the independent method in two aspects. First, under the coherent assumption, the sum of all the emitted photon energies add up to the total energy difference between initial and final levels. Second, in the coherent cascade, one must include all intermediate states, as in the case in higher perturbation theory. It is shown that the coherent method gives broader widths, and different intensity ratios from the standard calculation. The possible effects of coherence on the cascade is then discussed. (Diss. Abstr. Int., B)

21146 COMMENT ON "POSITRONIUM FORMATION IN THE NOBLE GASES." Paul, D. (Toronto Univ.). J. Phys., B (London); 8: No. 15, L377(21 Oct 1975).

The new results of Coleman, et. al., for the positronium formation fraction in helium are shown to be in agreement with earlier results of the present author. An earlier method based on Pond's method but without magnetic field is particularly free of systematic error. (auth)

21147 POSITRONIUM FORMATION IN THE NOBLE GASES. Coleman, P. G.; Griffith, T. C.; Heyland, G. R.; Killeen, T. L. (University Coll., London). J. Phys., B (London); 8: No. 10, L185-L189(11 Jul 1975).

Positronium formation fractions have been determined from lifetime experiments for all the noble gases. Taken in conjunction with the positron beam total cross section measurements of Canter et al, it is possible to estimate values for the positronium formation and positron excitation cross sections for helium and, with reduced accuracy, for neon and argon in the energy range from the positronium threshold E_0 to the ionization potential E_I. It is shown that these cross sections are approximately 0.2 πa_0^2 at E_I for helium and somewhat larger for neon and argon. (auth)

21148 POSITRON LIFETIME SPECTRA FOR THE NOBLE GASES. Coleman, P. G.; Griffith, T. C.; Heyland, G. R.; Killeen, T. L. (University Coll., London). J. Phys., B (London); 8: No. 10, 1734-1743(11 Jul 1975).

Lifetime spectra for positrons annihilating in helium gas have been measured at room temperature for gas densities up to 60 amagat. The equilibrium annihilation rate for the free positron component is proportional to the gas density D, in amagats, given by $\lambda_1 = (0.793 \pm 0.004)D\ \mu s^{-1}$ which is equivalent to $Z_{eff} = 3.94 \pm 0.02$ and is in good agreement with recent calculations. The variation of the equilibrium decay rate with gas density for the ortho-positronium component is also linear, given by $\lambda_2 = 7.24 + (0.1006 \pm 0.0006)D\ \mu s^{-1}$, which is consistent with pick-off quenching. No other long-lived component has been observed. For neon at room temperature, a shoulder region of width 1700 ± 200 ns amagat has been established. The equilibrium decay rates are $\lambda_1 = (1.205 \pm 0.015)D\ \mu s^{-1}$, equivalent to $Z_{eff} = 5.99 \pm 0.08$, and $\lambda_2 = 7.24 + (0.189 \pm 0.006)D\ \mu s^{-1}$. Some new measurements for argon, krypton and xenon are also reported. A comparison is made with other recent measurements. (auth)

Collision Phenomena

Refer also to abstracts 19697, 21129, 21148, and 21807.

21149 DISSOCIATION OF MOLECULES BY SLOW COLLISIONS WITH ATOMS. Devdariani, A.Z. Opt. Spectrosc. (USSR) 39: No. 3, 342-343 (Sept 1975).

The dissociation of molecules by collisions with excited atoms with the formation of an atom in an excited state is studied from the point of view of achieving population inversion in the atoms.(AIP)

21150 COHERENCE TRANSFER BETWEEN LEVELS OF HYPERFINE STRUCTURE OF ATOMS UNDER THE INFLUENCE OF NONRESONANCE COLLISIONS. 2. ALIGNMENT TRANSFER. Petrashen, A.G.; Rebane, V.N.; Rebane, T.K. Opt. Spectrosc. (USSR) 39: No. 3, 245-247 (Sept 1975).

Coefficients are calculated for the alignment transfer between levels of hyperfine structure (hfs) of atoms with electron momenta $j=1$, 1.5, and 2 and nuclear spins $i=0.5$, 1, 1.5, 2, 2.5, 3, and 3.5 under the influence of nonresonance collisions with atoms of a foreign gas. The results are tabulated. A concrete application of the results is illustrated in calculating numerical values of the effective cross sections for collisional transfer of alignment between hfs levels of the first excited $n^2P_{3/2}$ state of rubidium and cesium atoms. (auth)

21151 A STUDY OF MOLECULAR PAIR POTENTIALS: A SEMIEMPIRICAL APPROACH. Ellis, R.L. (Department of Chemistry, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 64: No. 1, 342-348 (1 Jan 1976).

An expression is developed for the short range molecular pair potentials within the framework of the Heitler–London approach for molecules in a closed shell state. Assumptions common with the CNDO/2 semiempirical method are employed in evaluating the molecular integrals. The final expression depends only on quantities related to the atoms making up each molecule. There are four such quantities; (1) the atom charge density P_m; (2) the atom core charge Z^c_m; (3) the distance between atoms r_{mn}; and (4) the value of two electron repulsion integrals between atoms γ_{mn}. In terms of these quantities the final expression has the simple form $E^{(1)}_{ab} = (-1)\ \Sigma_m{}^{(a)}\Sigma_n{}^{(b)}\ [P_m P_n \gamma_{mn}(Z^c_m/P_m + Z^c_n/P_n - 1) - Z^c_m Z^c_n r^{-1}_{mn}]$. Although several approximations are introduced to obtain this expression these are related to the evaluation of integrals, and no adjustable parameters are required for the evluation of $E^{(1)}_{ab}$. This potential is in good agreement with the results of *ab initio* calculations for the system He/H_2, Ne/H_2, and HF/HF. A comparison is also made with the results of the Gordon–Kim method for the system HF/HF. Both $E^{(1)}_{ab}$ and the Gordon–Kim method are found to give comparable results, but the method presented in this work is found to be computationally ~3000 times faster per data point. (auth)

21152 VARIATION IN DIFFERENTIAL AND TOTAL CROSS SECTIONS DUE TO DIFFERENT RADIAL WAVE FUNCTIONS. Williamson, W. Jr.; Greene, T. (Department of Physics and Astronomy, The University of Toledo, Toledo, Ohio 43606). Am. J. Phys. 44: No. 1, 26-28 (Jan 1976).

Three different sets of analytic wave functions are used to calculate the Na(3s→3p) differential and total electron excitation cross sections by using the Born approximation. As would be expected, significant differences in the results are found, and the calculation can be used as an example in elementary quantum mechanics to demonstrate just how much variation in the cross section and line strengths there is for Na(3s→3p). (auth)

21153 EFFECTS OF PARTIAL CROSS SECTIONS ON THE ENERGY DISTRIBUTION OF SLOW SECONDARY ELECTRONS. Tuckwell, H.C.; Kim, Y. (Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 64: No. 1, 333-336 (1 Jan 1976).

The shapes of the energy distribution of secondary electrons can be predicted for fast incident charged particles by using dipole oscillator strengths in conjunction with the Born formula. Target atoms or molecules may have one or more ionization potentials close to the first one and the corresponding partial photoionization cross sections are sometimes large. Allowance must then be made for the differences in kinetic energies of photoelectrons which leave alternative ionic states. This produces a significant change in the expected secondary electron spectrum at low energies. The photoionization data for NO are analyzed and the predicted shape of the secondary electron energy distribution agrees well with that of the experimental distribution at those secondary electron energies where a comparison is possible. Predicted low energy results from a preliminary analysis for N_2 are also reported. (auth)

21154 CHEMI-IONIZATION REACTIONS IN ACCELERATED URANIUM–O_2 CROSSED MOLECULAR BEAMS. Young, C.E.; Dehmer, P.M.; Cohen, R.B.; Pobo, L.G.; Wexler, S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 64: No. 1, 306-319 (1 Jan 1976).

Chemi-ionization and electron transfer reactions in accelerated uranium-atom–oxygen–molecule collisions have been studied by crossed molecular beam techniques: $U+O_2 \rightarrow UO^+_2+e$, associative ionization (1); $U+O_2 \rightarrow UO^+ + (O+e)$, rearrangement (reactive) ionization (2); $U+O_2 \rightarrow U^+ + (O_2+e)$, electron transfer (3). Cross sections for the three ionization channels were measured as a function of relative collision energy from 0.2 to 60 eV. The thresholds observed for channels (2) and (3), which are closed at thermal energies, are in good agreement with values calculated from thermochemical data. The cross section for associative ionization varied inversely with v_r, the relative collision velocity, as predicted for weak autoionizing transitions. With the use of a rough absolute calibration and a $1/v_r$ extrapolation to lower energies, the UO^+_2 cross section was found to be in agreement with the previously reported value measured with thermal beams. In the case of rearrangement ionization, the cross section rose rapidly at threshold, peaked near the threshold for the electron transfer process, and then declined with increasing collision energy. The electron transfer cross section increased with a power-law dependence of the excess energy above threshold throughout the range investigated. The maximum absolute cross section measured was 1.4×10^{-17} cm^2. The dynamics of ionization processes (2) and (3) were elucidated from the energy dependences of the cross sections and from measurements of the angular and kinetic energy distributions of the product ions. The results support the conclusion that rearrangement ionization proceeds by a "spectator-stripping" mechanism. Both the UO^+ from this reaction and the U^+ from electron transfer are scattered predominantly in the forward direction. (auth)

21155 DIFFERENTIAL CROSS SECTIONS FOR ELASTIC ELECTRON SCATTERING. II. CHARGE CLOUD POLARIZATION IN N_2. Herrmann, D.; Jost, K.; Kessler, J. (Physikalisches Institut, Westfälische Wilhelms Universität, Münster, Germany); Fink, M. J. Chem. Phys. 64: No. 1, 1-5 (1 Jan 1976).

Relative elastic differential cross sections for electron scattering from N_2 molecules have been measured with a crossed beam technique in order to investigate the influence of charge cloud polarization. The angular range studied was 3–135 deg and the electron energies were between 90 and 1000 eV. Comparison with theoretical calculations based on the independent atom model using partial wave atomic scattering factors shows strong deviations at small scattering angles. This discrepancy is discussed from the point of view of charge cloud polarization. It is found that calculations including an additional polarization potential improve the theoretical description of the experimental small angle data. (auth)

21156 SINGLE-ELECTRON BORN APPROXIMATIONS FOR CHARGE TRANSFER FROM MULTIELECTRON ATOMS TO PROTONS. Omidvar, K.; Golden, J.E.; McGuire, J.H. (Theoretical Studies Group, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771); Weaver, L. Phys. Rev. A 13: No. 1, 500-503 (Jan 1976).

The Born approximation, including the internuclear interaction, is used to compute cross sections for the transfer of one electron from a multielectron atom to an incident proton. When the full internuclear interaction is included, the results lie far above high-energy experimental *K*-shell data for p + Ar. However, when only enough internuclear interaction is used so that the total projectile-target interaction goes to zero asymptotically in accord with plane-wave functions actually used, fair agreement at high energies is obtained. The latter form of the Born approximation is compared to data on *K*-shell capture from helium as well as argon, in addition to the simpler approximation of Oppenheimer and of Brinkman and Kramers (OBK), where no internuclear interaction is included. The OBK results typically lie a factor of 2 to 8 above the data, while our Born results are within a factor of 2 of most of the existing high-velocity *K*-shell data, i.e., with an accuracy comparable to more sophisticated calculations. (auth)

21157 QUANTUM-MECHANICAL IMPULSE APPROXIMATION FOR VIBRO-ROTATIONAL EXCITATION IN ATOM-DIATOM COLLISIONS. Korsch, H.J.; Philipp, V. (Institut für Theoretische Physik I, Universität Münster, 44 Münster, Germany). Phys. Rev. A 13: No. 1, 497-499 (Jan 1976).

The quantum-mechanical impulse approximation (IA) has been successfully applied to vibrational and rotational excitation in atom–diatomic-molecule collisions. An additional closure approximation used previously to calculate total vibrational transition probabilities is discussed. A comparison with exact IA calculations shows that the closure approximation overestimates large vibrational transitions. This discrepancy is due to the fact that the vibrational transitions are accompanied by large rotational excitations. (auth)

21158 ELECTRON SCATTERING FROM ATOMS IN THE PRESENCE OF A LASER FIELD. Gersten, J.I.; Mittleman, M.H. (Physics Department, The City College of the City University of New York, New York, New York 10031). Phys. Rev. A 13: No. 1, 123-130 (Jan 1976).

The formal development of the problem of electron-atom scattering in the presence of a laser field is considered. A time-dependent close-coupling method and a time-dependent optical-potential method are presented. With hydrogen as an example, and a weak laser tuned near the 1*S*-2*P* resonance, the effective long-range potentials are explicitly obtained. These potentials are time dependent, noncentral, and fall off as r^{-n}, where we limit ourselves to terms with $n = 2$, 3, and 4. They are then used to find the elastic, inelastic, and superelastic cross sections for small momentum transfer. (auth)

21159 ELECTRON ENERGY LOSS MEASUREMENTS ON PYRENE ($C_{16}H_{10}$) VAPOR. Venghaus, H.; Hinz, H. (Institut für Angewandte Physik der Universität Hamburg, Hamburg, Federal Republic of Germany). J. Chem. Phys. 64: No. 1, 30-33 (1 Jan 1976).

Electron energy loss spectra from 0 to 25 eV were measured with 50 keV electrons on pyrene vapor. The results indicate the existence of five strong excitations between 3.9 and 7.0 eV, identified as π–π^* excitations. Four of them exhibit vibrational sublevels with 0.17 eV energy separation. Less pronounced maxima of the energy loss function are observed between 8 and 11 eV, which cannot be interpreted conclusively. Broader structures between 11 and 18 eV are attributed to excitations involving σ states. The present results are related to absorption measurements on pyrene in solution and to investigations of pyrene single crystals. Values for the solution and crystal shift of the different π–π^* excitations are obtained (~ -0.2 eV). (auth)

21160 ELASTIC AND NONELASTIC CROSS SECTIONS FOR Ar^* (^3P)+HBr($X\,^1\Sigma$). Fraites, J.L.; Winicur, D.H. (Chemistry Department and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 64: No. 1, 89-94 (1 Jan 1976).

The energy dependence of the differential scattering of metastable Ar^* (^3P) by ground state HBr($X\,^1\Sigma$) has been studied at four relative kinetic energies from 60–160 meV over an angular range of 4–120 deg c.m. The position and curvature of rainbow maxima, which are observed at each energy, are used to obtain LJ(12,6) potential parameters. The position of the minimum $r_m = 4.44 \pm 0.8$ Å is the same as that for K+HBr, and the well depth, $\epsilon = 25.2 \pm 1.1$ meV, is about 4% larger than ϵ (K+HBr). The scattered intensity shows a distinct falloff at large angles compared to that expected for elastically-scattered Ar^*. This depletion, caused by quenching of Ar^*, is analyzed in terms of an optical model to determine the threshold and energy dependence of the quenching cross section. The nonelastic cross section increases from a threshold of 25 meV to a nearly constant value of 41 Å^2 at 160 meV. The optical analysis predicts a maximum of 42.5 Å^2 at 215 meV. (auth)

21161 MULTIPLE SCATTERING IN THE COMPTON EFFECT. I. ANALYTIC TREATMENT OF ANGULAR DISTRIBUTIONS AND TOTAL SCATTERING PROBABILITIES. Tanner, A.C.; Epstein, I.R. (Department of Chemistry, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. A 13: No. 1, 335-348 (Jan 1976).

The probabilities of single and multiple Compton scattering and the angular distributions of scattered photons are analyzed in terms of the effects of sample geometry and details of the photon-electron interaction (form of the single-electron cross section). It is shown that the desired quantities may be calculated analytically if Thomson scattering and an appropriate geometry are assumed. Consideration of scattering using an isotropic cross section suggests that in most cases sample geometry is more important than the form of the cross section in determining the probability and angular distribution of single and multiple scattering. (auth)

21162 ENERGY TRANSFER BETWEEN SLOWLY MOVING ATOMS—THE CASE OF NO CROSSING POINT. Payne, M.G.; Nayfeh, M.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. A 13: No. 2, 595-598 (Feb 1976).

The classical path treatment of a collision between an excited atom and another atom with a nearly resonant energy level leads to coupled differential equations which have been discussed previously by many workers. Here we present an elementary procedure for solving this system of equations in the case of no crossing point and in the limit

where $\Delta E\tau \gg \hbar$, with ΔE being the energy discrepancy and $\tau = b/v$ being a measure of the time of collision. Even though the method is designed to take advantage of the slowness of the collision, it is also shown to be exact if $\Delta E = 0$. The form of the solution is very similar to that of Vainshtein *et al.*, but the present derivation avoids several of their approximations which individually are not as accurate as their final result. It is also pointed out that the coupled equations which arise for the energy-transfer problem also arise in connection with the interaction of laser pulses with atoms. Hence, the method has application to a wide class of multistate problems. A simple laser-interaction problem is discussed as a second example of the method. (auth)

21163 H-Ar POTENTIAL FROM HIGH-RESOLUTION DIFFERENTIAL CROSS-SECTION MEASUREMENTS AT THERMAL ENERGY. Bassi, D.; Dondi, M.G.; Tommasini, F.; Torello, F.; Valbusa, U. (Istituto di Scienze Fisiche dell'Università, Genova, Italy). Phys. Rev. A 13: No. 2, 584-594 (Feb 1976).

We report high-resolution differential cross-section measurements for the systems H-Ar and D-Ar at a relative energy of 67 meV. The primary beam is velocity selected (FWHM 10%) and the secondary beam is produced by a low-temperature source. The experimental resolution allows us to resolve the "fast-oscillation" structure of the cross section. Our experimental results are compared with the effective cross sections obtained from potentials recently proposed for these systems. The present data cannot accomodate the potential forms deduced from two separate measurements of the energy dependence of the total cross section, but are not in disagreement with the recent theoretical results of Wagner, Das, and Wahl. The sensitivity of the measured properties to the attractive and to the weakly repulsive parts of the potential is discussed, and we show that a compensation effect between the two does not allow a unique determination of the potential. (auth)

21164 CROSS SECTION FOR INDUCED X-RAY EMISSION IN SOME ELEMENTS BY 950-keV PROTONS. Milazzo, M. (Istituto di Fisica, Università di Milano, Italy); Riccobono, G. Phys. Rev. A 13: No. 2, 578-583 (Feb 1976).

The cross section for x-ray characteristic fluorescence excited by 950-keV protons has been measured for 12 elements: Cl, K, V, Cr, Fe, Ni, and Cu for *K*-shell emission and Rb, Y, Ag, Sm, and Gd for *L*-shell emission. The results for Cl, K, V, Rb, and Y are new data. We obtain $\sigma^{a}_{K} = 260 \pm 15\%$ for Cl, $\sigma^{a}_{K} = 121 \pm 15\%$ for K, $\sigma^{a}_{K} = 22.7 \pm 10\%$ for V, $\sigma^{a}_{L} = 405 \pm 15\%$ for Rb, and $\sigma^{a}_{L} = 350 \pm 15\%$ for Y, all cross sections (in barns) having been measured at 950-keV proton energy. Moreover, we deduce for Y a new value of $\bar{\omega}_{L} = 0.14 \pm 15\%$. The results for the remaining elements are compared with the results of similar measurements. The experimental values are also compared with the predictions of the binary-encounter approximation and of the binding-energy-corrected plane-wave Born approximation. Both theories predict higher *K*-shell ionization cross sections than observed. (auth)

21165 *K*-SHELL IONIZATION OF LIGHT ELEMENTS BY PROTON AND HELIUM-3-ION IMPACT. Tawara, H.; Hachiya, Y. (Nuclear Engineering Department, Kyushu University, Fukuoka, Japan); Ishii, K.; Morita, S. Phys. Rev. A 13: No. 2, 572-577 (Feb 1976).

K-shell ionization cross sections for Al and Si by proton and ^{3}He-ion impacts have been measured with thin targets and a proportional counter over the projectile energy range 0.75–4 MeV/amu. The results, together with others on light elements, are compared with theoretical predictions based on the plane-wave Born approximation and the binary-encounter approximation, and it is found that the scaling law, taking into account the effects of the Coulomb deflection of the projectile and the increase of binding energy of *K*-shell electrons, gives a good fit to the experimental results over the entire energy range measured. Ratios of the *K*-shell ionization cross sections for helium-ion impact to those for proton impact show deviations from the Z^{2}_{1} dependence predicted by the Coulomb interaction theory. Possible reasons for this deviation are discussed. (auth)

21166 MEASUREMENTS OF BEAM-FOIL ELECTRONS EMITTED NEAR 0° FROM H^{+} AND H_{2}^{+} ON CARBON IN THE ENERGY RANGE 0.175–1.0 MeV/amu. Duncan, M.M.; Menendez, M.G. (Department of Physics and Astronomy, The University of Georgia, Athens, Georgia 30602). Phys. Rev. A 13: No. 2, 566-571 (Feb 1976).

We have measured electron energy distributions in the angular range 0°–6° for ion energies in the energy range 0.175–1.0 MeV/amu. A predominant group of electrons whose velocities are centered about the ion velocity is always observed. For this group of electrons, angular distributions have been deduced. Dependences on foil thickness and ion configuration, H^{+} or H^{+}_{2}, have been investigated. Our results are consistent with a charge-exchange process being the dominant mechanism for producing these electrons. (auth)

21167 IMPACT-PARAMETER DEPENDENCE OF MOLECULAR ORBITAL X RAYS PRODUCED BY COLLISIONS OF I WITH Au. Jundt, F.; Guillaume, G.; Fintz, P.; Jones, K.W. (Laboratoire de Physique Nucléaire et d'Instrumentation Nucléaire, Centre de Recherches Nucléaires et Université Louis Pasteur, Strasbourg, France). Phys. Rev. A 13: No. 2, 563-565 (Feb 1976).

The coincidence spectra of molecular orbital x rays produced in the scattering of a beam of 26.85-MeV I ions by Au at laboratory angles of 1.5, 3.5, and 10.5 deg have been measured. Analysis of the data gives the energy dependence and approximate cross section for the molecular-orbital x rays for the combined system with $Z = 132$ as a function of impact parameter. The results confirm and extend the conclusions drawn from previous measurements of the x-ray singles spectrum. (auth)

21168 EXCITATION OF ATOMIC HYDROGEN IN THE eikonal-Born-series APPROXIMATION. Byron, F.W. Jr.; Latour, L.J. Jr. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. A 13: No. 2, 649-664 (Feb 1976).

The eikonal-Born-series method, developed recently to analyze elastic scattering of electrons by atomic hydrogen and helium, is extended to inelastic scattering. In this paper we investigate the excitation of atomic hydrogen to the 2*s* or 2*p* state by electron bombardment. Important differences from the elastic case are discussed and a careful comparison with the Glauber method is made. Also, for angles greater than 20° comparison is made with recent experimental data on the sum of the differential cross sections for 2*s* and 2*p* excitation. Very good agreement is found. (auth)

21169 PROJECTILE-CHARGE DEPENDENCE OF THE *K* X-RAY EMISSION CROSS SECTION OF CARBON BOMBARDED BY MEGAVOLT NITROGEN IONS. Martin, F.W.; Cacak, R.K. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. A 13: No. 2, 643-648 (Feb 1976).

The carbon *K* x-ray emission cross section of methane molecules bombarded by 1- to 5-MeV nitrogen ions has been measured for incident charges +2 to +5 under single-collision conditions. Only x rays with energies which penetrate the polypropylene window of a proportional counter are counted. The cross sections increase monotonically with ion energy. Above 2 MeV they also increase with ion charge, to a maximum of nearly 10^{-18} cm^{2}. (auth)

21170 DIABATIC MOLECULAR STATES AND THE SHIELDED DIATOMIC ORBITALS METHOD: THEORETICAL STUDY OF He^{+} + D INELASTIC COLLISIONS. Aubert, M. (Laboratoire de Chimie-Physique, Bât. 404, Institut National des Sciences Appliquées de Lyon and Laboratoire de Spectroscopie et Luminescence, 69621 Villeurbanne, France); Le Sech, C. Phys. Rev. A 13: No. 2, 632-642 (Feb 1976).

Within the one-configuration molecular-orbital scheme, diabatic molecular states of the molecular ion HeD^{+} involved in the collisional process He^{+} + D are determined by the shielded diatomic orbitals (SDO's) method. These SDO's are exact solutions of the one-electron–two-center problem with an effective parametric potential. This potential, which preserves the separability in prolate spheroidal coordinates of the Schrödinger equation, is obtained by classical electrostatic considerations. Differential cross sections for the He^{+}D colliding system are determined by a semiclassical collisional method. Good agreement is found with recent experimental results in the keV energy range. (auth)

21171 DIFFERENTIAL CROSS SECTIONS FOR ELECTRON-IMPACT IONIZATION OF HELIUM. Burnett, T.; Rountree, S.P.; Doolen, G. (Physics Department, Texas A&M University, College Station, Texas 77843); Robb, W.D. Phys. Rev. A 13: No. 2, 626-631 (Feb 1976).

In an earlier paper a general formulation of differential cross sections for electron-impact ionization of atomic systems, in the Born approximation, was presented. The present work uses this formulation, with simple correlated wave functions, to evaluate various differential cross sections for electron-impact ionization of helium. The results are compared with previous experimental and theoretical data. The favorable agreement obtained with experiment for high incident-electron energies and low ejected-electron energies in both double- and single-differential cross sections is indicative of the agreement which can be expected when the same procedure is applied to the electron-impact ionization of other atoms. (auth)

21172 PARAMETER-VARIATION CALCULATIONS OF e^{-}H ^{1}S SCATTERING RESONANCES. Perkins, J.F. (U.S. Army Missile Command, Redstone Arsenal, Alabama 35809). Phys. Rev. A 13: No. 2, 622-625 (Feb 1976).

A recently proposed anomaly-free averaged Kohn parameter-variation method has been used for calculations of the two lowest ^{1}S resonances in e^{-}H scattering. Calculated phase shifts at a number of points spanning each resonance can be fitted rather closely with a one-level resonance formula, and the resulting widths are in reasonable agreement with results of other workers. (auth)

21173 ELECTRON DETACHMENT FROM NEGATIVE IONS: THE EFFECTS OF ISOTOPIC SUBSTITUTION. Champion, R.L.;

Doverspike, L.D.; Lam, S.K. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). Phys. Rev. A 13: No. 2, 617-621 (Feb 1976).

Absolute total electron-detachment cross sections and relative elastic-scattering cross sections are presented for collisions of H^- (D^-) + He, Ne, Ar, N_2 for collision energies ranging from about 2 eV up to 100 eV. Special emphasis has been given to the effect of isotopic substitution. It was found that, with the exception of the helium target, the results cannot be in accord with a model using a localized complex potential. On the other hand, the results for H^- (D^-) + He are in excellent agreement with predictions based upon a previous (local complex potential) analysis of differential elastic-scattering measurements. (auth)

21174 COLLISIONAL DETACHMENT IN COLLISIONS OF Cl^- WITH THE RARE GASES. Champion, R.L.; Doverspike, L.D. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). Phys. Rev. A 13: No. 2, 609-616 (Feb 1976).

Absolute total electron detachment and relative elastic differential cross sections for the scattering of Cl^- by Ne, Ar, Kr, and Xe have been measured at energies ranging from near detachment threshold to 180 eV. The experimental results have been analyzed by using semiclassical expressions for the cross sections which involve localized complex potentials. Reasonable potentials have been deduced which yield calculated cross sections that are in good agreement with the experimental observations. (auth)

21175 SOLUTIONS OF LAPLACE AND SCHROEDINGER EQUATIONS. Sukumar, C. V. Pittsburgh; Univ. of Pittsburgh (1974). 96p. University Microfilms Order No. 75-18,259. Thesis (Ph. D.).

A numerical solution of Laplace equation for a quadrupole mass spectrometer is given. In conjunction with experimental investigations of the characteristics of quadrupole mass spectrometers, a Green's function technique is developed to permit accurate computation of the fields inside the spectrometer. This technique proves to be considerably more efficient than the standard methods presented in the literature. An accuracy of about eight significant figures for the potential is achieved with very little computational effort. Regge poles in atomic physics are discussed. In potential scattering theory the partial wave sum can be replaced, through the Watson-Sommerfeld transform, by a summation over contributions from Regge poles, together with a background integral. It was previously suggested that this technique may be useful in studying ion-atom collisions. In electron-atom scattering at energies of the order of 100 eV the observed differential scattering cross sections suggest that the scattering amplitude might be dominated by the contribution from one or two poles. Two techniques were developed through which the positions of the Regge poles and the associated residues of the S-matrix can be determined. A variational principle was derived which is useful for electron-atom collisions and direct integration methods using complex coordinates are used for ion-atom systems. Calculations were performed on potentials representing e-Ar and H^+-Ar interactions, and good agreement was obtained with previous theories and with experiment. If the scattering amplitude were in fact dominated by a single Regge pole, the extension of these calculations to multichannel problems would be relatively simple. However, it appears that this will be the case only at relatively high energies. (Diss. Abstr. Int., B)

21176 TEMPERATURE DEPENDENCE OF THE SPIN–ORBIT RELAXATION OF LEAD, $6p^2(^3P_2)$ AND $(^3P_1)$. Trainor, D.W.; Ewing, J.J. (Avco Everett Research Laboratory, Inc., Everett, Massachusetts 02149). J. Chem. Phys. 64: No. 1, 222-227 (1 Jan 1976).

Rate constants for the collisional deactivation of Pb $6p^2(^3P_2)$ and $(^3P_1)$ metastable states are reported over the temperature range 300 to 600 °K. Quenching data over this temperature range were obtained for relaxation by Ar, Xe, H_2, D_2, N_2 and by Hg at 373 °K. These results were obtained in a temperature controlled, flash photolysis apparatus using tetramethyl lead as a precursor and time resolved atomic resonance absorption techniques for monitoring the $^3P_2$ and $^3P_1$ metastable states of interest. (auth)

21177 PHOTOELECTRIC INTERACTION BELOW THE *K* EDGE. Reddy, D.K.S.; Premachand, K.; Radha Krishna Murty, V.; Rama Rao, J.; Lakshminarayana, V. (Laboratories for Nuclear Research, Andhra University, Waltair, India). Phys. Rev. A 13: No. 1, 326-329 (Jan 1976).

Total photon cross sections are measured, using the transmission method in the heavy elements U, Th, Pb, and Au at energies of 30.9, 35.9, and 55.4 keV, to study the photoelectric interaction below the *K* edges of these elements. A krypton-filled proportional counter with a 512-channel analyzer is used as the detector of photons. The photoelectric cross sections, obtained by subtracting the small scattering contributions from the total cross section, are compared with theoretical predictions of Scofield and of Storm and Israel. General agreement is obtained, except for U and Th at 30.9 keV where the present experimental values show a slight preference to the calculations of Storm and Israel rather than the theoretical ones used by Scofield. (auth)

21178 LINE BROADENING OF THE $3s_2$-$2p_8$ LASER TRANSITIONS OF NEON. Knutson, J.W. Jr.; Bennett, W.R. Jr. (Dunham Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 13: No. 1, 318-325 (Jan 1976).

Doppler and collision broadening were studied on six $2p^5\,5s \rightarrow 2p^5\,3p$ transitions of Ne I. Line-broadening parameters were extracted using the method of least squares in the computer analysis of spontaneous emission profiles transmitted through a scanning plane-parallel Fabry-Perot interferometer. ^{20}Ne-^{4}He and ^{20}Ne-^{20}Ne Lorentz broadening parameters are tabulated, and their temperature dependence summarized. (auth)

21179 *Kα* X-RAY SATELLITE INTENSITIES WITH PROTON IMPACT ON Al TO Fe AT A FIXED SCALED VELOCITY. Dutkiewicz, V.; Bakhru, H.; Cue, N. (Physics Department, State University of New York at Albany, Albany, New York 12222). Phys. Rev. A 13: No. 1, 306-311 (Jan 1976).

The *Kα* x-ray satellite intensities were measured with proton impact at a scaled velocity (relative to that of the *L*-shell electron) $V_L = 2.1$ for $Z = 13$–20 and $V_L = 1.0$ for $Z = 20$–26. The intensity ratios $I_{K,1L}/I_{K,0L}$ are found to be well characterized by multiple-Coulomb ionization predictions. Taking into account the fluorescence yields, the comparisons of the measured intensity ratio with the corresponding ratio of theoretical vacancy cross sections yield a set of empirical vacancy-rearrangement correction factors. Theoretical estimates of these factors based on the atomic transition rates of McGuire are in reasonable over-all agreement with the extracted values. (auth)

21180 LOW-ENERGY SCATTERING OF ELECTRONS BY ATOMIC OXYGEN. Tambe, B.R.; Henry, R.J.W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. A 13: No. 1, 224-228 (Jan 1976).

The method of polarized pseudostates has been used to calculate cross sections for the elastic scattering of electrons by atomic oxygen. These pseudostates are added to the close-coupling expansion to give a polarization potential in agreement with experimental values of polarizability. The resulting elastic cross sections are in good agreement with other theoretical calculations as well as with experiment for energies up to 10 eV. The reactance matrices obtained in this calculation have been used to calculate collision strengths for fine-structure transitions in the ground-state ^3P term for electron temperatures above 5000 ° K. (auth)

21181 LOW-ENERGY ELECTRON-IMPACT EXCITATION OF THE HYDROGEN MOLECULE. Rescigno, T.N.; McCurdy, C.W. Jr.; McKoy, V. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125); Bender, C.F. Phys. Rev. A 13: No. 1, 216-223 (Jan 1976).

We present cross sections for the excitation of the two lowest ($b\,^3\Sigma^+_u$ and $a\,^3\Sigma^+_g$) triplet states of molecular hydrogen by electron impact for incident electron energies ≤ 20 eV. The cross sections are calculated using the distorted-wave approximation with the inelastic transition density obtained in the random-phase approximation. An efficient expansion technique using Gaussian basis functions allows us to avoid numerical integrations and to treat accurately the noncentral nature of the scattering process with full allowance for electron exchange. The sum of the two triplet cross sections is found to be in good agreement with the experimental cross section for dissociation of H_2 into 2H. (auth)

21182 EXPERIMENTAL IMPACT-PARAMETER–DEPENDENT PROBABILITIES FOR *K*-SHELL VACANCY PRODUCTION BY FAST HEAVY-ION PROJECTILES. Randall, R.R.; Bednar, J.A.; Curnutte, B.; Cocke, C.L. (Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 13: No. 1, 204-215 (Jan 1976).

The impact-parameter dependence of the probability for production of target *K* x rays has been measured for oxygen projectiles on copper and for carbon and fluorine projectiles on argon at scaled velocities near 0.5. The O-on-Cu data were taken for 1.56-, 1.88-, and 2.69-MeV/amu O beams incident upon thin Cu foils. A thin Ar-gas target was used for 1.56-MeV/amu C and F beams, permitting measurements to be made for charge-pure C^{+4}, C^{+6}, F^{+9} and F^{+5} projectiles. Ar and Cu *K* x rays were observed with a Si(Li) detector and scattered projectiles with a collimated surface-barrier detector. Comparison of the shapes of the measured *K*-vacancy–production probability curves with predictions of the semiclassical Coulomb approximation (SCA) shows adequate agreement for the O-on-Cu system. For the higher ratio of projectile-to-target nuclear charge (Z_1/Z_2) characterizing the C-on-Ar and F-on-Ar systems, the SCA predictions are entirely inadequate in describing the observed impact-parameter dependence. In particular, they cannot account for large probabilities found at large impact parameters. Furthermore, the dependence of the shapes on the projectile charge state

is found to become pronounced at larger Z_1/Z_2. Attempts to account for this behavior in terms of alternative vacancy-production processes are discussed. (auth)

21183 HYBRID THEORY AND CALCULATION OF e-N_2 SCATTERING. Chandra, N.; Temkin, A. (Theoretical Studies Group, Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, Maryland 20771). Phys. Rev. A 13: No. 1, 188-203 (Jan 1976).

A theory of electron-molecule scattering is developed which is a synthesis of close-coupling and adiabatic-nuclei theories. Specifically, the theory is close coupling with respect to vibrational degrees of freedom but adiabatic-nuclei with respect to rotation. In addition, this theory can be applied to any number of partial waves required; the remaining ones can be calculated purely in one or the other approximation. A theoretical criterion based on fixed-nuclei calculations and not on experiment can be given as to which partial waves and energy domains require the various approximations. The theory allows all cross sections (i.e., pure rotational, vibrational, simultaneous vibration-rotation, differential, and total) to be calculated. Explicit formulas for all these cross sections are given. The theory is applied to low-energy e-N_2 scattering. The fixed-nuclei results are such that the criterion shows clearly that vibrational close coupling is necessary, but only for the Π_g partial wave. The contribution of remaining partial waves can be obtained directly from the adiabatic-nuclei approximation. The close-coupling calculation for the Π_g wave is carried out, and we find that it does give rise to the substructure as well as the gross structure of the 2.4-eV resonance. When this amplitude is combined with the adiabatic amplitudes, we can compute absolute values of all cross sections of interest. In particular we find that vibrational excitation cross sections are about twice as large as previously inferred. The momentum-transfer cross section can also be computed, and it too reveals substructure within the gross structure resonance. (auth)

21184 THEORETICAL CROSS SECTIONS FOR H-on-Cs IONIC AND NEUTRAL REACTIONS. Olson, R.E. (Service de Physique Atomique, Centre d'Etudes Nucléaires de Saclay, 91190 Gif-sur-Yvette, France); Shipsey, E.J.; Browne, J.C. Phys. Rev. A 13: No. 1, 180-187 (Jan 1976).

Potential-energy curves and coupling matrix elements have been calculated for the CsH and CsH^+ systems. The potentials and coupling terms were employed in the coupled equations where the nuclear motion is described classically to obtain the energy dependence of the cross sections for energies 0.1–3.0 keV. The cross sections so obtained were: Q_{+0} for the reaction $H^+ + Cs \rightarrow H + Cs^+$, Q_{+-} for $H^+ + Cs \rightarrow H(2s) + Cs^+$, Q_{-0} for $H^- + Cs^+ \rightarrow H + Cs$, and Q_{0-} for $H(1s) + Cs \rightarrow H^- + Cs^+$. The CsH potential-energy curves were also used to estimate the ionization cross section $Q_{ion\text{-}Cs}$ for $H^- + Cs \rightarrow H^- + Cs^+ + e$ and $Q_{ion\text{-}H}$ for $H^- + Cs \rightarrow H + Cs + e$, and to yield an upper-limit cross section Q_{n-} for the reaction $H(2s) + Cs \rightarrow H^- + Cs^+$. Semiempirical calculations were employed to obtain the deactivation cross section Q_{mg} for $H(2s) + Cs \rightarrow H(2p) + Cs$ where the product $H(2p)$ rapidly radiates to H(1s). At 0.5 keV the theoretical cross sections obtained were $Q_{+0} = 1.2 \times 10^{-14}$, $Q_{+-} = 5.5 \times 10^{-15}$, $Q_{-0} = 1.5 \times 10^{-14}$, $Q_{0-} = 8.2 \times 10^{-16}$, $Q_{ion\text{-}Cs} = 1.3 \times 10^{-15}$, $Q_{ion\text{-}H} = 2.9 \times 10^{-15}$, $Q_{mg} = 8.1 \times 10^{-15}$, and $Q_{n-} \approx 4 \times 10^{-16}$ cm^2. For the reactions where experimental data are available, the theoretical cross sections are in satisfactory agreement with experiment except for Q_{0-}, where the theoretical values are approximately a factor of 5 larger than the experimental values. (auth)

21185 MICROWAVE TRANSIENT-RESPONSE MEASUREMENTS OF ELASTIC MOMENTUM-TRANSFER COLLISION FREQUENCIES IN ARGON. McPherson, D.A.; Feeney, R.K.; Hooper, J.W. (Georgia Institute of Technology, School of Electrical Engineering, Atlanta, Georgia 30332). Phys. Rev. A 13: No. 1, 167-179 (Jan 1976).

A microwave transient-response technique has been used to determine electron-neutral elastic momentum-transfer collision frequencies in argon as a function of electron energy in the range from 0.08 to 4 eV. An analytical technique has been developed for the unfolding of the monoenergetic collision-frequency data from the measured transient-response decay rate. The over-all experimental and analytical error is estimated to be less than ± 25% except in the immediate vicinity of the argon Ramsauer minimum where the transient-response results may considerably overestimate the true collision frequency. The results are compared with argon collision-frequency data derived from previous dc swarm measurements and modified effective-range conversions of total elastic scattering data. The transient-response results agree well with the dc swarm data except at the Ramsauer minimum, where the transient-response data agree more closely with the modified effective-range results. (auth)

21186 ELECTRON IMPACT EXCITATION OF THE 3S, 3P, AND 3D STATES OF H. Mahan, A.H.; Gallagher, A.; Smith, S.J. (Joint Institute for Laboratory Astrophysics, National Bureau of Standards and University of Colorado, Boulder, Colorado 80302). Phys. Rev. A 13: No. 1, 156-166 (Jan 1976).

The relative excitation function for electron impact excitation of H to yield Balmer α has been measured from threshold to 500-eV collision energy in a crossed-beam apparatus. The relative contributions of the 3S, 3P, and 3D states to this excitation function have been measured by modulating the electron beam and discriminating on the basis of their different lifetimes for radiative decay after excitation. The resulting set of relative 3S, 3P, and 3D cross sections has been normalized by equating the total measured Balmer-α cross section at 500 eV to the Born approximation. The normalized cross sections are then compared to available theories at lower energies. In contrast to virtually all known excitation cross sections of neutral atoms, which fall below the Born theory at low energies, the H ($1S \rightarrow 3D$) cross section exceeds the Born theory, apparently owing to coupling between the 3D and 2P states. (auth)

21187 EXCITATION OF THE Mg AND Mg^+ RESONANCE LINES BY ELECTRON IMPACT ON Mg ATOMS. Leep, D.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). Phys. Rev. A 13: No. 1, 148-155 (Jan 1976).

We have measured the optical excitation functions and polarizations of the Mg resonance line (2852 Å) and of the Mg^+ resonance lines (2796 Å, 2803 Å, unresolved) arising from ionizing excitation of magnesium atoms, for electron-impact energies from the excitation thresholds to 1400 eV. In our crossed-beam apparatus, the electron-beam energy resolution was ≃0.25 eV for energies below 10 eV, and the atom beam was optically thin. The excitation function of the ionic lines was normalized to that of the atomic line by relative intensity measurements. The 2852-Å excitation function, when normalized to Born theory in the high-energy limit, has a maximum cross section of $17.3\,\pi a_0^2 \pm 3\%$ at 18.5 eV. This excitation function is graphically compared with the resonance-line excitation functions of Na, Ca, and Li previously measured in this laboratory. The 2852-A polarization function is consistent with the theoretical threshold limit of +100%, and has a sharp feature near 5 eV which cannot be due to cascading. (auth)

21188 RADIATIVE TRANSITIONS IN ATOM-ATOM SCATTERING IN INTENSE LASER FIELDS. Lau, A.M.F. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. A 13: No. 1, 139-147 (Jan 1976).

The quantum nonperturbative analysis of Kroll and Watson for a two-level system of near-adiabatic atom-atom scattering in an intense laser-field mode is extended to treat a general multilevel system interacting with intense single- or many-field modes. A procedure for rigorously solving the adiabatic eigenvalue problem for the whole charge-field system is given. A new transition-probability formula is derived. Cross sections are calculated for the processes $Li + H(X\,^1\Sigma^+) + \nu\hbar\omega \rightarrow Li + H(A\,^1\Sigma^+ \text{ or } B\,^1\Pi)$ where $\nu \geq 1$. Analysis of transition in an atom due to intensity variation of a laser pulse shows that desired transition probability per pulse (e.g., 1/2) may be achieved by varying the pulse parameters. For this, numerical results of $Na(3s) + 2\hbar\omega \rightarrow Na(5s)$ and of $Li(2s) + 8\hbar\omega \rightarrow Li(3s)$ are given. (auth)

21189 ANGULAR SCATTERING OF LOW-ENERGY ELECTRONS BY ATOMIC OXYGEN. Dehmel, R.C.; Fineman, M.A.; Miller, D.R. (Department of Applied Mechanics and Engineering Sciences, University of California, San Diego, La Jolla, California 92093). Phys. Rev. A 13: No. 1, 115-122 (Jan 1976).

The differential cross sections for electrons scattered by He, O, Ar, and O_2 at 15 eV and by O and O_2 at 5 eV have been determined using a modulated crossed-beam technique. The results for He, Ar and O_2 agree well with previously published experimental and theoretical values. Measurements on O_2 extend to larger back-scattered angles than previously reported. Results for O are compared with the theoretical calculations of Thomas and Nesbet. Reasonable agreement with theory is obtained at 5 eV, and while the calculations only extend to 11.0 eV, the trend in shape appears correct at 15 eV. A small-angle dip in the cross section is observed which is not predicted by the theory. (auth)

21190 MULTISTATE CURVE-CROSSING MODEL FOR SCATTERING: ASSOCIATIVE IONIZATION AND EXCITATION TRANSFER IN HELIUM. Cohen, J.S. (Theoretical Division (T-6), Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. A 13: No. 1, 99-114 (Jan 1976).

A model has been derived to treat the multistate curve-crossing problem which often arises in diabatic representations of scattering processes. Transitions between diabatic states are assumed to occur only in the vicinity of curve crossings and the probabilities are evaluated semiclassically. Otherwise the nuclear trajectories are treated classically except for tunneling through long-range potential barriers taken into account by the JWKB approximation. Closed channels are included on an equal footing with the scattering channels. The model is applied to the problems of symmetric associative (and dissociative) ionization and excitation transfer in collisions of excited helium with the ground-state

atom, using the diabatic representation for the Rydberg states of He_2 presented in the preceding paper. The electronic coupling of the repulsive diabatic states in the continuum yields much larger ionization cross sections than does direct vibronic coupling of low-lying adiabatic states to the continuum. The diabatic-states model is shown to be a valid interpretation of associative ionization in helium. Ionization has a significant effect on some excitation-transfer cross sections. Integrated cross sections are presented for ionization of helium in the $n\,^3S$, $n\,^3P$, and $n\,^3D$ states, $n = 3,4$, and for excitation transfer from the $n = 3$ states to states with $2 \leq n \leq 4$ for collision energies from thermal to 100 eV. The thermally averaged associative ionization cross sections, in units of 10^{-16} cm^2, obtained at 300 °K are as follows: $\bar{Q}(3\,^3S) = 0.06$, $\bar{Q}(3\,^3P) = 2.0$, $\bar{Q}(3\,^3D) = 2.9$, $\bar{Q}(4\,^3S) = 0.6$, $\bar{Q}(4\,^3P) = 1.7$, and $\bar{Q}(4\,^3D) = 4.3$. The results are in quite satisfactory agreement with recent experiments. (auth)

21191 DIABATIC-STATES REPRESENTATION FOR HE* ($n \geq 3$) + He COLLISIONS. Cohen, J.S. (Theoretical Division (T-6), Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. A 13: No. 1, 86-98 (Jan 1976).

A diabatic-states representation for scattering of triplet helium atoms, with $n \geq 3$, by the ground-state helium atom is presented. *Ab initio* calculations have been performed on the $^3\Sigma^+_{g,u}$, $^3\Pi_{g,u}$, and $^3\Delta_g$ Rydberg states of He_2. Matrix elements for radial and angular coupling between the orthogonalized diabatic states have also been evaluated. The angular couplings are quite weak, with the result that molecular states with different electronic symmetries are effectively uncoupled in low-energy collisions. The crossing by a repulsive diabatic-potential curve through the Rydberg series and into the continuum is shown to be an effective mechanism for associative ionization. Some qualitative observations on associative ionization and dissociative recombination are made. (auth)

21192 IONIZATION, CHARGE EXCHANGE, AND EXCITATION IN F + Ar AND F + Kr COLLISIONS. Hopkins, F.; Brenn, R.; Whittemore, A.R. (Department of Physics, State University of New York, Stony Brook, New York 11794); Cue, N.; Dutkiewicz, V.; Chaturvedi, R.P. Phys. Rev. A 13: No. 1, 74-85 (Jan 1976).

We have measured projectile and target x-ray cross sections for F + Ar and F + Kr collisions using fluorine beams of charge states 7+, 8+, and 9+ with energies from 20 to 76 MeV. Pronounced enhancements for the Ar *K* and Kr *L* vacancy cross sections using F^{9+} ions compared to those for the 7+ projectile can be explained by charge exchange as described by an empirically scaled Brinkman-Kramers theory. The Ar *L*, Kr *K*, and Kr *M* cross sections are found to exhibit features expected for Coulomb ionization. The projectile *K* x-ray production for the 9+ ion is accounted for by charge exchange processes. Predictions of the first Born approximation for direct single-step excitation to bound states by the target nucleus overestimate the observed cross sections for F^{7+} and F^{8+}. (auth)

21193 ELECTRON-IMPACT EXCITATION OF ATOMIC OXYGEN. Smith, E.R. (Air Force Cambridge Research Laboratories, Hanscom AFB, Massachusetts 01731). Phys. Rev. A 13: No. 1, 65-73 (Jan 1976).

The excitation cross sections $Q\,(^3P\text{-}3s\,^3S^o)$ and $Q\,(^3P\text{-}3s\,^5S^o)$ are calculated using a close-coupling formalism, which includes exchange effects. A cascade-adjusted cross section for $Q\,(^3P\text{-}3s\,^3S^o)$ is obtained which agrees with the experimental cross section of Stone and Zipf within estimated error uncertainties. Finally, some discussion is given concerning the effects of poorly positioned O^- autodetaching states, which are introduced by an inadequate close-coupling expansion. (auth)

21194 ABSOLUTE EXPERIMENTAL CROSS SECTION FOR THE IONIZATION OF Tl^+ IONS BY ELECTRON IMPACT. Divine, T.F.; Feeney, R.K.; Sayle, W.E. II; Hooper, J.W. (School of Electrical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332). Phys. Rev. A 13: No. 1, 54-57 (Jan 1976).

Absolute cross sections for the single ionization of Tl^+ ions by electron impact have been measured as a function of electron energy from below threshold to approximately 2000 eV. It was found that the cross section increased from a zero value at and below threshold to a maximum value of about 1.7×10^{-16} cm^2 at an incident electron energy of approximately 100 eV. Measurements were made in a crossed-beam facility operating in the pulsed-beam mode. Numerous consistency checks were performed to evaluate possible sources of experimental error. (auth)

21195 TRANSITION RADIATION FOR THE DIAGNOSIS OF LOW-ENERGY ELECTRON BEAMS. Mahan, A.H.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). Rev. Sci. Instrum. 47: No. 1, 81-83 (Jan 1976).

Electron bombardment of metallic silver is known to produce "transition radiation," predominantly at 300–450 nm wavelengths. In reported measurements at 15–500 eV impact energies, transition radiation was used to diagnose the shape and time dependence of an rf modulated electron beam. It is suggested that this is a superior target, as opposed to phosphors or gases normally used, to determine instrumental time response functions and electron beam imaging. (auth)

21196 ON THE BEST AVERAGE TRAJECTORY IN THE VICINITY OF ENERGETIC THRESHOLD. Billing, G.D. (Institute for Chemistry, Faculty of Medicine, Rådmandsgade 71, Copenhagen 2200 N, Denmark). J. Chem. Phys. 64: No. 2, 908-909 (15 Jan 1976).

The low temperature values of the He-H_2 relaxation time are calculated using the arithmetic mean velocity rather than the geometric mean velocity. (AIP)

21197 INFINITE-ORDER SUDDEN APPROXIMATION FOR ROTATIONAL EXCITATION OF HYDROGEN MOLECULES BY ELECTRONS IN THE ENERGY RANGE 10–40 eV. Truhlar, D.G.; Poling, R.E.; Brandt, M.A. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). J. Chem. Phys. 64: No. 2, 826-829 (15 Jan 1976).

Electron scattering by H_2 is treated using a noncentral interaction potential including short-range and long-range static contributions, exchange, and polarization effects. The molecule is treated as a rigid rotator and the scattering is treated in the infinite-order sudden approximation. The results show that the rotational excitation cross section exceeds the elastic scattering cross section at large scattering angles at intermediate energies but not at small angles at low energies. (auth)

21198 CROSS SECTIONS FOR ROTATIONAL ENERGY TRANSFER: AN INFORMATION-THEORETIC SYNTHESIS. Procaccia, I.; Levine, R.D. (Departments of Chemistry and Physics, The University of Texas, Austin, Texas). J. Chem. Phys. 64: No. 2, 808-817 (15 Jan 1976).

State-to-state cross sections are readily computed by combining the capabilities of the classical trajectories method with an information-theoretic ("surprisal") synthesis. The method is illustrated by an application to rotational energy transfer in several systems, (Ar+N_2, $Li^+ + H_2$, $Li^+ + D_2$, H+CO). It is shown that by using classical trajectories to compute a single moment of the distribution of final rotational energy (for a given initial rotational energy) and then maximizing the entropy of the distribution subject to the given value of the moment one can obtain a good prediction of the distribution. Invoking microscopic reversibility, the entire matrix of state-to-state, $\sigma(j \to j')$, rotational energy transfer cross sections (at the given total energy) is then determined. More averaged quantities, such as the cross sections for inelastic collisions $\sigma(j)$, are thereby easily obtained. When a realistic potential energy surface is not available or when one requires a simple but reliable prediction, the synthesis can be based on invoking a sum rule. Here the moment of the distribution is not computed via classical trajectories but is expressed as a simple function of the initial conditions. It is shown that available cross sections often satisfy the simplest possible sum rule and hence a synthesis can be readily carried out where the only inputs are the total energy and the rotational constant of the diatomic molecule. The distribution of final rotational states predicted in this way is independent of the nature of the collision partner. The method is illustrated by applications to H+CO, Ar+N_2, $Li^+ + H_2$, He+HD, H+H_2, and H+D_2. Results for the distribution of final rotational state and the dependence of the cross section on the initial rotational state and on the collision energy are in very good accord with classical trajectory and with quantal close-coupling computations. (auth)

21199 SURPRISAL ANALYSIS AND PROBABILITY MATRICES FOR ROTATIONAL ENERGY TRANSFER. Levine, R.D.; Bernstein, R.B.; Kahana, P.; Procaccia, I.; Upchurch, E.T. (Department of Physical Chemistry, The Hebrew University, Jerusalem, Israel). J. Chem. Phys. 64: No. 2, 796-807 (15 Jan 1976).

The information-theoretic approach is applied to the analysis of state-to-state rotational energy transfer cross sections. The rotational surprisal is evaluated in the usual way, in terms of the deviance of the cross sections from their reference ("prior") values. The surprisal is found to be an essentially linear function of the energy transferred. This behavior accounts for the experimentally observed exponential gap law for the hydrogen halide systems. The data base here analyzed (taken from the literature) is largely computational in origin: quantal calculations for the hydrogenic systems H_2+H, He, Li^+; HD+He; D_2+H and for the N_2+Ar system; and classical trajectory results for $H_2 + Li^+$; $D_2 + Li^+$ and N_2+Ar. The surprisal analysis not only serves to compact a large body of data but also aids in the interpretation of the results. A single surprisal parameter θ_R suffices to account for the (relative) magnitude of all state-to-state inelastic cross sections at a given energy. (auth)

21200 TOTAL INELASTIC CROSS SECTIONS FOR POTASSIUM ION–ATOM COLLISIONS: OSCILLATIONS IN THE VELOCITY DEPENDENCE AND CORRELATION WITH MOLECULAR STRUCTURE. Aquilanti, V.; Casavecchia, P. (Dipartimento di Chimica dell'Università, 06100 Perugia, Italy). J. Chem. Phys. 64: No. 2, 751-759 (15 Jan 1976).

Electronic excitation leading to light emission in the wavelength range 350–800 nm has been studied by a crossed ion–atom beam technique for

(K^+, K) collisions, and the results are interpreted in terms of properties of the potential energy curves for the molecular ion K^+_2. The investigated velocity range is (1.3–12) $\times 10^6$ cm s^{-1}. The total cross section for the process $K^+(3p^6\ ^1S_0) + K(4s\ ^2S_{1/2}) \rightarrow K^+(3p^6\ ^1S_0) + K(4p\ ^2P_{3/2,1/2})$ increases from threshold up to $\sim 10^{-15}$ cm^2 at a velocity of $\sim 4.5\times 10^6$ cm s^{-1}, and shows an oscillatory structure. The magnitude and over-all velocity dependence are attributed to a Σ–Π curve crossing, and the oscillations to an interference effect which is treated as an inelastic "glory" phenomenon. Cross sections for production of each of the fine structure components of $K(4p)$, $^2P_{3/2}$, and $^2P_{1/2}$, have also been measured. Their ratio, which in the investigated velocity range is different from the statistical value, shows additional oscillations, which are discussed in terms of long range interference between alternate semiclassical paths. (auth)

21201 VELOCITY DEPENDENCE OF ELECTRONIC EXCITATION TRANSFER REACTIONS: $(CO^*,N_2^*,Kr^*) + Hg(6\ ^1S_0) \rightarrow (CO,N_2,Kr) + Hg(6\ ^3P_1)$. Lee, W.; Martin, R.M. (Department of Chemistry, University of California, Santa Barbara, California 93106). J. Chem. Phys. 64: No. 2, 678-685 (15 Jan 1976).

The velocity dependences of the sensitized fluorescence of mercury by metastable $CO(a\ ^3\Pi)$, $N_2(A\ ^3\Sigma^+_u)$, and $Kr(5\ ^3P_{2,0})$ were determined using crossed molecular beams with the metastable beams time-of-flight velocity selected. With $CO(a)$ and $N_2(A)$ excitation is directly to $Hg(6\ ^3P_1)$, whereas with $Kr(^3P)$ higher triplet states of mercury are also excited. The collisional energy ranges studied with CO, N_2, and Kr were 32–516, 30–468, and 31–394 meV, respectively. The cross section collisional velocity dependence was found to be quite similar for the three systems, with a negative v^{-n} velocity dependence in the low velocity region becoming neutral or positive at higher velocities. The values of n were 0.750 ± 0.014 for $CO(a)$ + Hg up to 242 meV, 1.009 ± 0.016 for $N_2(A)$ + Hg up to 202 meV, and 0.810 ± 0.024 for $Kr(^3P)$ + Hg up to 140 meV. The results are compared with velocity dependences of other nonadiabatic reactions, and discussed in terms of electronic coupling vs curve crossing theories for such processes. (auth)

21202 A MANY-BODY APPROACH TO THE VIBRATIONAL STRUCTURE IN MOLECULAR ELECTRONIC SPECTRA. II. APPLICATION TO NITROGEN, CARBON MONOXIDE, AND FORMALDEHYDE. Domcke, W.; Cederbaum, L.S. (Physik-Department der Technischen Universität München, Institut für Theoretische Physik, Reaktorgelände, Garching, Germany). J. Chem. Phys. 64: No. 2, 612-625 (15 Jan 1976).

The theory developed in the preceding paper is applied to calculate the vibrational structure in optical absorption and electron impact spectra of N_2 and CO and in the photoelectron spectra of H_2CO and D_2CO. In addition, the vibrational structure of a recently measured shake-up line in the photoelectron spectrum of N_2 is computed. The influence of anharmonicity effects on the Franck–Condon factors is discussed and a very simple scheme to take these effects into account is proposed. The one-particle approximation is shown to provide a fairly accurate picture in most cases. For formaldehyde many-body effects are incorporated into the vibrational coupling constants, leading to an improved agreement with experiment for all bands. The assignment of the third and the fourth ionization potential of formaldehyde, which has been controversial, is clarified. (auth)

21203 $A\ ^3\Sigma^+_u$ MOLECULES IN THE N_2 AFTERGLOW. Shemansky, D.E. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). J. Chem. Phys. 64: No. 2, 565-580 (15 Jan 1976).

Excitation of N_2 by electrons with energy below the ionization threshold produces a strong afterglow in the $B\ ^3\Pi_g$–$A\ ^3\Sigma^+_u$ system. The precursor is identified as the $A\ ^3\Sigma^+_u$ state in the $v>6$ vibrational levels. The peak electron cross section of the $A\ ^3\Sigma^+_u$–$X\ ^1\Sigma^+_g$ system is estimated at about three times the $B\ ^3\Pi_g$–$X\ ^1\Sigma^+_g$ transition. Deactivation rates of the $A\ ^3\Sigma^+_u$ $v>6$ levels by $X\ ^1\Sigma^+_g$ molecules vary over the $8E-12$ cm^3sec^{-1}–$5E-11$ cm^3sec^{-1} range. There is some evidence that the higher levels may relax at rates comparable to that of electronic deactivation. Deactivation of $B\ ^3\Pi_g$ by $X\ ^1\Sigma^+_g$ molecules has a strong dependence on the vibrational level of the $B\ ^3\Pi_g$ state. The rate coefficients for this process vary between $1E-11$ cm^3sec^{-1} and $1E-10$ cm^3sec^{-1}, with no measureable contribution by vibrational relaxation. The results suggest that production rates of the $B\ ^3\Pi_g$ state in the Lewis–Rayleigh (L–R) afterglow are much more uniformly distributed over the vibrational levels than has been previously assumed. We also suggest it is unlikely that significant amounts of energy pass through the $^5\Sigma^+_g$ state in the L–R afterglow. About 25% of the energy of atomic nitrogen recombination enters the $B\ ^3\Pi_g$ state in the L–R afterglow, according to the present results. The factors controlling the $A\ ^3\Sigma^+_u$ $v=0,1$ population in the L–R afterglow appear to be much less well defined than has been suggested in previous literature. (auth)

21204 CROSS SECTIONS AND RATE CONSTANTS FOR LOW-TEMPERATURE ^4He–H_2 VIBRATIONAL RELAXATION. Alexander, M.H. (Department of Chemistry, University of Maryland, College Park, Maryland 20742); McGuire, P. J. Chem. Phys. 64: No. 2, 452-459 (15 Jan 1976).

Converged coupled-states integral cross sections were determined for the vibrational relaxation of the $v=1$ $j=0$ level of p-H_2 in collisions with ^4He. The collision energies ranged from 0.005 to 0.4 eV. The Gordon–Secrest (GS) potential was used with both a harmonic (HO) and rotating-Morse oscillator (MO) description of the H_2 molecule. Additional calculations incorporated modifications in the long-range and spherically symmetric (V_0) parts of the purely repulsive GS surface. Rotational coupling plays a major role in vibrational relaxation even at thermal energies. Although the relative importance of individual vibration–rotation transitions is a sensitive function of the choice of intramolecular potential, the HO and MO total relaxation cross sections are nearly identical. These total relaxation cross sections exhibit a power-law dependence on the initial translational energy down to $\sim$0.1 eV above threshold; below which point a positive curvature appears for all the surfaces considered. Rate constants for vibrational relaxation were computed and compared with experiment for $60\ ^\circ K < T < 500\ ^\circ K$. The GS rates lie below the experimental values and exhibit a less pronounced curvature at low temperatures. Introducing the correct long-range attraction into the GS V_0 potential results in a modest increase in curvature. Agreement with experiment is obtained only with the use of the semiempirical V_0 potential of Shafer and Gordon. (auth)

21205 VACUUM-ULTRAVIOLET EMISSION FROM HIGH-PRESSURE KRYPTON. Koehler, H. A.; Ferderber, L. J.; Redhead, D. L.; Ebert, P. J. (Univ. of California, Livermore). Phys. Rev., A; 12: No. 3, 968-973 (Sep 1975).

Krypton gas was excited by high-current relativistic electron bursts, and spectral and temporal characteristics of the uv continuum peaked at 1460 A were measured as functions of pressure. Gas pressure ranged from 0.14 to 68 atm. The spectral full width at half-maximum of 90 +- 6 A was virtually independent of pressure from 3.4 to 68 atm. Exponential time constants for the buildup and decay of the uv intensity obeyed a $P^{-1.5}$ pressure dependence for P less than 4 atm. Three pressure-independent intensity decay constants of 9 +- 1.5, 32 +- 6, and 350 +- 70 nsec were obtained for P greater than 6 atm. The efficiency for conversion of electron kinetic energy to uv energy was (4 +- 1.6) percent. (auth)

21206 IONIZATION IN Ar + Ar COLLISIONS: SMALL ANGLE MEASUREMENTS OF IONIZATION PROBABILITY AND INELASTIC ENERGY LOSS AT LOW keV INCIDENT ENERGIES. Eriksen, F. J. Storrs, CT; Univ. of Connecticut (1975). 120p. University Microfilms Order No. 75-18,332.

Thesis (Ph. D.).

Ionization probabilities are measured from 2.0^0 to 12.0^0 lab scattering angle at 2.00, 2.50 and 3.00 keV incident lab energy, and preliminary data are taken in the same angular range at 0.50, 0.75, 1.00 and 1.50 keV. The ionization probability shows an abrupt increase with inflection point at 6.0 keV-deg, and a slower rise above 25 keV-deg. The scattered ion beam is energy analyzed at various incident energies and scattering angles. For tau less than or equal to 12 keV-deg there is a double peaked structure for all spectra, one peak at 18 eV and the other at 29 eV. For larger tau, there is predominantly one energy loss peak at 43 eV. The data suggest that the 18 eV peak is produced by unbound negative ion excitation, and the 29 eV and 43 eV peaks are produced by excitation to autoionizing states. (Diss. Abstr. Int., B)

21207 ELASTIC AND INELASTIC SCATTERING OF H^- AND D^- BY INERT GAS ATOMS. Lam, S. K. Williamsburg, VA; Coll. of William and Mary (1975). 168p. University Microfilms Order No. 75-27,622.

Thesis (Ph. D.).

Measurements and calculations have been made of elastic scattering and electron detachment in collisions of H^- and D^- with He and Ar at c.m. energies of 5–120 eV. The mechanism responsible for electron detachment is assumed to be the crossing of the H^- bound state with the continuum of free states; the bound state is then assigned a complex energy. The measured elastic differential cross sections show no structure except at some particular values of E theta, where there are regions of downward curvature in the graphs of log sigma vs theta. These are interpreted as the threshold angles for electron detachment, and are directly related to the crossing points. By empirically fitting the experimental differential cross sections, the general features of the complex potentials are obtained. Theory predicts an isotope effect in the elastic differential cross section, and this effect provides a test of the theory. A careful series of experiments on the H^--(D^-)–He systems displayed the effect. Elastic scattering of H^-(D^-) by the other inert gases (Ne and Xe) has also been measured. In addition, preliminary measurements of the detached electron energy spectra have been made. These various aspects of the present studies indicate that at low energies the experimental results are in general compatible (or at least not incompatible) with the complex potential theory. In the energy range investigated, two inelastic scattering channels other than electron detachment

have been observed, namely, double electron detachment and excitations of target gases. The mechanisms for these inelastic processes are interpreted qualitatively within the electron promotion model. Some semi-quantitative analysis of the excitation process has been attempted in terms of a non-crossing model recently developed by Dinterman and Delos. (Diss. Abstr. Int., B).

21208 ELECTRON IMPACT EXTRACTION OF ATOMS AND MOLECULES. Chen, S. T. Fayetteville, AR; Univ. of Arkansas (1975). 195p. University Microfilms Order No. 75-27,695.

Thesis (Ph. D.).

Atomic and molecular collision processes are studied using both theoretical and experimental techniques. The theoretical work utilizes the Glauber approximation to study electron-helium scattering, while the experimental work uses time-resolved spectroscopy to examine electron-nitrogen molecule collision processes. (Diss. Abstr. Int., B)

21209 SPIN ANALYSIS OF ELECTRON ATOM COLLISIONS. Blum, K.; Kleinpoppen, H. (Univ. of Stirling, Scotland). Int. J. Quant. Chem., Symp.; No. 9, 415-424(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Investigations are considered in which either the increasing electrons or the atomic target system or both of the collision partners are polarized. The spin analysis of electron-atom scattering with spin-$\frac{1}{2}$ atoms (one-electron system) is covered and basic spin reactions are described and quantified in terms of scattering amplitudes. A general theory of spin polarization phenomena in collisions between electrons and atoms with arbitrary polarization state is given. 18 refs (GHT)

21210 ELASTIC SCATTERING CROSS SECTIONS OF METASTABLE BARIUM ON HELIUM AND ARGON. Sheppard, A. R. Buffalo; State Univ. of New York (1975). 163p. University Microfilms Order No. 75-18,843.

Thesis (Ph. D.).

Barium atoms in the $^1D_2$, $^3D_2$ and $^3D_3$ metastable excited states have been observed by their low field Zeeman resonances using an Atomic Beam Magnetic Resonance Spectrometer. The $^1S_0$ ground state is also observed. The scattering of Ba atoms in each of these states by helium or argon atoms (in their ground states) was performed by allowing a secondary beam to intersect the Ba beam at 90^0 (crossed beam geometry). The ratio of the cross sections for scattering from different excited Ba states and the same target atom was measured to a precision of 1 to 2 percent. By a combination of further experiment and calculation the absolute cross sections were also measured. It is argued that the elastic scattering dominates so that the measured cross section is sigma/sub elastic/. Comparison of the scattering of Ba($^1S_0$) and Ba(^{1},$^3D_{2,3}$) for either target gas shows that the ground state cross section is larger by a factor of 1.8 than for the excited states. This somewhat surprising result is in accord with naive pictures of the "size" of the 5d 6s electronic configuration of the excited barium compared with the ground state configuration, $6s^2$. (Diss. Abstr. Int., B)

21211 THREE-DIMENSIONAL QUANTUM MECHANICAL STUDIES OF THE H + H_2 AND F + H_2 REACTIONS. Redmon, M. J.; Wyatt, R. E. (Univ. of Texas, Austin). Int. J. Quant. Chem., Symp.; No. 9, 403-414(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

New results are presented for quantum mechanical reactive scattering in H + H_2, including a comparison of close-coupling cross sections for para to ortho conversion with results obtained through momentum decoupling approximations. Information-theoretic analysis of product rotational distributions is given for one total energy. Results are also presented of the first three-dimensional coupled-channel study of the F + H_2 reaction, showing the energy dependence of the probability distribution for vibrational excitation and population inversion. (auth)

21212 ATOM–MOLECULE REACTIVE COLLISIONS: A COMBINED EXPERIMENTAL AND THEORETICAL RESEARCH PROJECT. Nesbet, R. K. (IBM Research Lab., San Jose, CA). Int. J. Quant. Chem., Symp.; No. 9, 397-401(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A joint experimental and theoretical project has been set up to study the basic mechanisms of atom–molecule reactive collisions. Research will be coordinated in four areas, all relevant to the overall project, but traditionally undertaken as separate disciplines. These areas are reactive collision experiments, collision theory, computation of potential surfaces, and theoretical quantitative spectroscopy. Projects and current research in these areas are described. (auth)

21213 CROSSED-BEAM STUDIES OF THE HYDROGEN EXCHANGE REACTIONS: THE REACTIONS OF H AND D ATOMS WITH T_2 MOLECULES. Lo, V. W. S. Stony Brook, NY; State Univ. of New York (1975). 164p. University Microfilms Order No. 75-24,638.

Thesis (Ph. D.).

The hydrogen exchange reactions: H + T_2 yields HT + T, D + T_2 yields DT + T have been studied by a crossed molecular beam technique using radioisotope labeling. The complete in-plane angular distributions of T-atoms produced in these reactions have been measured using MoO_3 as a chemical target detector. (Diss. Abstr. Int., B)

21214 ELECTRON ALKALI SCATTERING BY POLARIZED ELECTRONS. Pai, R. Y. New York; New York Univ. (1975). 174p. University Microfilms Order No. 75-28,575.

Thesis (Ph. D.).

An apparatus was designed and constructed as a first step towards performing a bona fide polarized electron scattering experiment. A polarized electron beam has been produced and its polarization measured. An intense beam of polarized potassium atoms has also been produced and its polarization measured. It has been shown that a true polarized electron-polarized atom scattering experiment is feasible and that in the next generation of this apparatus improvements in the intensity and polarization of both the electron beam and the atom beam are possible and will allow measurements on polarized systems to be made. (Diss. Abstr. Int., B)

21215 BRANCHING RATIOS IN REACTIVE COLLISIONS: THEORY VERSUS EXPERIMENT. Bernstein, R. B. (Univ. of Texas, Austin). Int. J. Quant. Chem., Symp.; No. 9, 385-395 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Recent experimental and theoretical studies of branching ratios in elementary bimolecular reactions are reviewed. Examples include both direct- and complex-mode reactions of neutral reagents yielding alternative sets of products (neutral or ionic as the case may be). The information-theoretic approach to branching ratios (and intramolecular isotope effects) for direct, exoergic reasons is illustrated. Recent molecular beam experiments on the energy dependence of the branching ratio for the decay of alkali halide–alkali collision complexes are discussed. (auth)

21216 ELECTRONIC STATES OF IONS RECOILING INTO VACUUM AND GASES. Datz, S. (Oak Ridge National Lab., TN). Phys. Scr.; 11: 149-156(1975).

In the study of hyperfine interactions of nuclear states created by nuclear reaction or Coulomb excitation the recoiling ion undergoes a series of collisions in which electrons are captured and lost and in which electronic excitation and deexcitation take place. A knowledge of the electronic states of the ion on a time scale comensurate with the lifetime of the nuclear states (1 to 100 ps) is vital to the understanding of the field at the nucleus. Atomic collision processes in dilute and dense media are discussed in terms of charge changing and excitation of both inner and outer shell electrons and the application to some perturbed angular correlation measurements are given.

21217 ASYMMETRIC SCATTERING OF ELECTRONS IN METALS. Hurd, C. M. (National Research Council of Canada, Ottawa). Contemp. Phys.; 16: No. 6, 517-532(Nov 1975).

Itinerant electrons moving in a metal under the influence of an applied electric field suffer momentum-changing collisions from numerous causes: collisions with their own kind, with native or foreign ions, or with any other deviation from the periodicity of the ideal lattice structure. The subjects of much recent research are those collisions which have left-right asymmetry; that is, the scattered electron has an unequal probability of passing to one side of the scatterer rather than to the other. Such asymmetric effects are most prominent in the case of scattering by an ion which has a localized magnetic moment and is in an applied magnetic field, although in principle any scattering center having an attractive potential can give asymmetric scattering. This article gives an elementary and descriptive review of the microscopic processes leading to such scattering, and covers recent developments in their macroscopic manifestations. (auth)

21218 CALCULATION OF ELECTRON OR POSITRON-ATOM SCATTERING LENGTHS USING APPROXIMATE TARGET WAVE-FUNCTIONS. Page, B. A. (Univ. of Western Ontario, London). J. Phys., B (London); 8: No. 15, 2486-2499(21 Oct 1975).

Results of calculations on the positron-hydrogen and electron-

hydrogen scattering systems at zero energy using distorted hydrogen-like target wavefunctions are presented. A trial wavefuntion, Ψ_t, which contains both linear and nonlinear parameters is constructed using an approximate target wavefunction. Ψ_t is related to a quantity, a_v, which becomes the Kohn scattering length if the target wavefunction is exact, through an integral expression corresponding to a slight modification of the usual Kohn variational method. On comparing the results obtained with the definitive values for these systems, it is conjectured that if the values of a_v display a local minimum when all the nonlinear parameters of Ψ_t are varied, then this local minimum value of a_v is an upper bound on the exact scattering length. Calculations on the Zero-energy positron-helium scattering system using Hylleraas-type approximations to the helium ground-state wavefunction are analyzed using this criterion. It is concluded that the use of either a six-parameter or a ten-parameter Hylleraas-type approximation to the helium ground-state wavefunction can give good results in scattering calculations for the positron-helium system at zero energy. (auth)

21219 THEORETICAL TREATMENT OF ATOMIC COLLISIONS AT INTERMEDIATE ENERGIES AND HIGHLY EXCITED STATES. Flannery, M. R. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); 8: No. 15, 2470-2485(21 Oct 1975).

A theoretical description of transitions in electron-atom and heavy particle collisions (with and without rearrangement) at intermediate energies is developed. The associated T matrices involve the solution of an integral equation describing elastic scattering by fixed centers. The solution, once determined, can be used to examine the full array of transitions for any given system. An effectively exact description of e, H^+-H(n) collisions is proposed. With certain simplifying assumptions the multiple scattering problem by fixed centers is solved, thereby providing a useful description of A-H(n) collisions. Various approximate schemes capable of systematic improvement are constructed. The approach can also be applied to ionization problems. (auth)

21220 NEW MULTISTATE SEMICLASSICAL ORBITAL TREATMENT OF HEAVY-PARTICLE. Flannery, M. R.; McCann, K. J. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); 8: No. 15, L387-L393(21 Oct 1975).

A new semiclassical description of elastic and inelastic scattering in heavy-particle collisions is presented and, when applied to H-H_2 collisions at 0.25 to 1.5 eV, yields result in close accord with detailed quantal calculations. (auth)

21221 K-SHELL IONIZATION BY RELATIVISTIC ELECTRONS. Dangerfield, G. R.; Spicer, B. M. (Melbourne Univ.). J. Phys., B (London); 8: No. 10, 1744-1751(11 Jul 1975).

The cross section for K-shell ionization in nickel, silver, and gold by electrons of energy between 3 and 30 MeV has been measured by counting the K x-rays produced. The results are compared with a virtual-photon calculation using two different forms for the x-ray photoeffect cross section, and also with the theory of Kolbenstvedt. (auth)

21222 TEN-CHANNEL EIKONAL TREATMENT OF DIFFERENTIAL AND INTEGRAL CROSS SECTIONS AND OF THE (λ, χ) PARAMETERS FOR THE n = 2 AND 3 EXCITATIONS OF HELIUM BY ELECTRON IMPACT. Flannery, M. R.; McCann, K. J. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); 8: No. 10, 1716-1733(11 Jul 1975).

A ten-channel eikonal treatment of the n = 2 and 3 collisional excitations of helium by incident electrons with energy E(eV) in the range $40 \leq E \leq 500$ is performed. Differential and integral inelastic cross sections are obtained, together with theoretical predictions of the (λ,χ) parameters which provide, as functions of scattering angle θ and E, the orientation and alignment vectors and the circular polarization fraction of the radiation emitted from the n^1P levels. The results are in satisfactory agreement with recent measurements. (auth)

21223 SECOND BORN APPROXIMATION TO ELECTRON AND POSITRON IMPACT EXCITATIONS OF THE $1^1S \rightarrow 2^1S$ TRANSITION IN HELIUM. Buckley, B. D.; Walters, H. R. J. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 10, 1693-1715(11 Jul 1975).

It is shown that the third-order second Born approximation, in which the second Born cross section is evaluated correct to only third order in the interaction potential, gives poor results for electron impact electron impact excitation of the $1^1S \rightarrow 2^1S$ transition. The full second Born approximation, in which cross sections are calculated by squaring the modulus of the full second Born amplitude, is better but still not quite satisfactory. A corrected simplified second Born approximation is proposed in which couplings between the 1^1S and 2^1S states are given special treatment. The new approximation is in good agreement with experiment except at low energies and large angles. The large forward peak obtained in some theoretical calculations on electron impact excitation is shown to be erroneous and due to insufficient cancellation of the 2^1P intermediate state contribution to the $1^1S \rightarrow 2^1S$ cross section. Some care has been taken to perform accurate second Born calculations by making use of very accurate first Born matrix elements published in the literature. Error estimates on the calculations are quoted. The closure energy Δ required in the closure approximation to the infinite summation over intermediate states in the second Born amplitude is determined by fitting to experimental data. (auth)

21224 ELECTRON SCATTERING FROM HYDROGEN ATOMS. II. Elastic Scattering at Low Energies From 0.5 to 8.7 eV. Williams, J. F. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 10, 1683-1692(11 Jul 1975).

Absolute angular differential cross sections for the elastic scattering of electrons from atomic hydrogen have been measured for incident energies from 0.5 to 8.7 eV and for scattering angles between 10 and 150 degrees. The relative angular distributions were made absolute within 6% by means of a phaseshift analysis around the $(1s2s^2)^2S$ resonance elastic scattering in helium coupled with relative beam density measurements using an oil manometer in the source region. The angular behavior of the cross section is consistent with a partial-wave explanation. The absolute cross section values agree within the experimental accuracy at all energies with the values predicted by the variational method, the best polarized-orbital calculations and the close-coupling with pseudostates approximations, that is with those methods which include the full polarizability of the ground state of atomic hydrogen. Other approximation values fall outside the present experimental limits in the forward direction. (auth)

21225 ELECTRON SCATTERING FROM ATOMIC HYDROGEN. I. Differential Cross Sections for Excitation of the n = 2 States. Williams, J. F.; Willis, B. A. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 10, 1641-1669(11 Jul 1975).

Absolute differential cross sections for electrons losing 10.2 eV in exciting the n = 2 states of atomic hydrogen have been measured over the angular range 20 to 140 degrees for incident electron energies of 54 to 680 eV. The experimental method is discussed in detail. Absolute cross section values have oeen determined by a method based on (i) a phaseshift analysis of the elastic differential scattering of electrons from resonant states, the $(1s2s^2)^2S$ state in helium and the $(3s^23p^64s^2)^2P_{\frac{1}{2}}$ and $^2P_{\frac{3}{2}}$ states in argon and (ii) measurement of beam source pressures. At all energies and scattering angles greater than 30°, the experimental values are not in agreement with any value predicted from the theories of the first Born approximation, both with and without exchange, the Glauber, distorted wave, three-state close-coupling, Coulomb-projected Born and second-order-potential close-coupling approximations. A detailed comparison of theoretical and experimental cross section values is presented. (auth)

21226 ELASTIC AND INELASTIC ELECTRON–HYDROGEN SCATTERING BY THE FADDEEV APPROACH. Saha, B. C.; Ghosh, A. S.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 8: No. 10, 1627-1640 (11 Jul 1975).

Elastic and 2s, 2p excitation cross sections for electron-hydrogen collisions have been investigated by an approximate form of the Faddeev equations, taking into account the coupling of the 1s, 2s, and 2p states of the target atom. Results with and without the inclusion of the exchange effect have been presented and compared with other theoretical findings. Present results neglecting exchange are the same as those obtained by previous workers. In the case of elastic scattering, the effect of exchange is not negligible even at the incident energy 500 eV. The results for the 1s-2s and 1s-2p excitation cross sections including exchange are in very good agreement with the experimental findings. (auth)

21227 DIFFERENTIAL CROSS SECTION OF MULTIPHOTON IONIZATION. Gontier, Y.; Rahman, N. K.; Trahin, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys., B (London); 8: No. 10, L179-L182(11 Jul 1975).

Differential cross sections for multiphoton ionization of atomic hydrogen are calculated for the range of two photons to eight photons. Some possible applications of such information are suggested. (auth)

21228 ONE-PARTICLE CENTRAL POTENTIAL FOR INELASTIC COLLISIONS OF FAST CHARGED PARTICLES WITH ATOMS. Yu, S. (Pittsburgh Univ.). J. Phys., B (London); 8: No. 10, 1752-1755(11 Jul 1975).

For the calculation of generalized oscillator strengths of atoms, the use of a one-particle central potential which treats the Coulomb interaction correctly and has the exchange effect as a small correction is advocated. This potential is used to calculate the generalized oscillator strengths for 2s and 3s excitation of the helium atom, and the results are found to be superior to Herman-Skillman calculations. (auth)

Atomic Theory

Refer also to abstracts 21118, 21128, 21134, 21209, 21788, 21789, 21872–21877, 21879, and 21880.

21229 CALCULATION OF ENERGIES OF AUTOIONIZING STATES OF MULTIPLY CHARGED IONS USING PERTURBATION THEORY. Gurchumeliya, A.D.; Oboladze, N.S.; Safronova, U.I. Opt. Spectrosc. (USSR) 39: No. 3, 248-250 (Sept 1975).

Energies of the autoionizing states of heliumlike ions were calculated using relativistic and nonrelativistic perturbation theory. The agreement of results obtained by the two methods is discussed. The energy of an atom is represented in the form of the sum $E=E_{00}Z^2+E_{10}Z+E_{20}+\alpha^2E_{01}Z^4+\beta^2E_{11}Z^3$. Numerical values of the coefficients E_{nm} were found for the $2s^2\ {}^1S_0$, $2p^2\ {}^3P_0$, $^3P_1$, $^3P_2$, $^1D_2$, and $^1S_0$ autoionizing levels. Energies of these states were calculated for Z=6, 8, 12, 20, and 26. (auth)

21230 RADIATION-INDUCED EXCITATION OF AUTOIONIZING STATES OF HELIUMLIKE IONS. Khristenko, S.V. Opt. Spectrosc. (USSR) 39: No. 3, 251-253 (Sept 1975).

Radiation-induced excitation of autoionizing atomic states was examined on the basis of Feshbach's formalism and perturbation theory for the electron-electron interaction. The relationships obtained were applied to the study of resonance photoionization of heliumlike ions in their ground state. Fano parameters were represented in an explicit form using hypergeometric functions. Numerical calculations were carried out for transitions to states with $n_1, n_2 \leqslant 4$. (auth)

21231 PHASE-SPACE DESCRIPTION OF OSCILLATORY SUPERFLUORESCENCE. Gronchi, M.; Lugiato, L.A. (Instituto di Scienze Fisiche dell'Università, Milano, Italy). Phys. Rev. A 13: No. 2, 830-852 (Feb 1976).

The "superfluorescence equations" deduced in a previous paper are generalized to the case of finite temperature and translated into the atomic coherent-state representation of Arecchi *et al.* We get three coupled partial differential equations involving the quasiprobability distribution $Q(\theta,t)$ of the atomic system and two suitable functions $F(\theta,t)$ and $M(\theta,t)$ describing the stimulated processes which are relevant in oscillatory superfluorescence. Neglecting $F(\theta,t)$ and $M(\theta,t)$, the equation for $Q(\theta,t)$ reduces to the Fokker-Planck equation of Narducci *et al.* corrected by the contribution of thermal noise. The stationary solution is given by the unperturbed canonical state, which is shown to be the *exact* stationary solution of the single-mode model from which the superfluorescence equations have been deduced. These equations prescribe that $M(\theta,t)$ always remain equal and opposite to $F(\theta,t)$, so that the superfluorescence equations reduce automatically to two equations. Eliminating $F(\theta,t)$ between the two remaining equations, one obtains a non-Markovian equation for $Q(\theta,t)$ with derivatives of all orders in θ. In the case of pure superfluorescence or super-radiance, such an equation reduces to a Markovian Fokker-Planck equation with derivatives of first and second order in θ which exhibits an interesting fourth-order contribution in the diffusion term. In fact, if one excludes a very small region around the north pole of the Bloch sphere, this term is much larger than the second-order contribution in the diffusion term of the equation of Narducci *et al.* In the case of oscillatory superfluorescence, the presence of memory effects enhances fluctuations, thus forbidding the existence of "classical" time evolutions. (auth)

21232 COMPLETE REDISTRIBUTION IN THE TRANSFER OF RESONANCE RADIATION. van Trigt, C. (Philips Research Laboratories, Eindhoven, The Netherlands). Phys. Rev. A 13: No. 2, 734-751 (Feb 1976).

The assumption of complete redistribution in frequency used in the theory of transport of resonance radiation, when Doppler broadening is important, is shown to predict the correct number densities in the excited levels at large optical depth. The line shape, however, is not a Doppler distribution in the wings but decreases like effects. (auth)

21233 ANALYTICALLY SOLVABLE PROBLEMS IN RADIATIVE TRANSFER. IV. van Trigt, C. (Philips Research Laboratories, Eindhoven, The Netherlands). Phys. Rev. A 13: No. 2, 726-733 (Feb 1976).

The Biberman-Holstein integral equation is solved for an infinite cylinder in the limit of large optical thickness and for a wide class of absorption profiles. Special attention is paid to the Voigt profile. (auth)

21234 SELF-CONSISTENT FIELD WITH PSEUDOWAVEFUNCTIONS. Szasz, L. (Department of Physics, Fordham University, New York, New York 10458). J. Chem. Phys. 64: No. 2, 492-499 (15 Jan 1976).

A computational method is given in which the energy of an atom is computed by using pseudowavefunctions only. The method centers on a model energy expression E_M which is similar to the Hartree–Fock energy expression, but contains only pseudowavefunctions. A theorem is proved according to which the Hartree–Fock orbitals can be transformed by a linear transformation into a set of uniquely defined pseudowavefunctions which have the property that when substituted into E_M this quantity will closely approximate the Hartree–Fock energy E_F. The new method is then formulated by identifying the total energy of an atom with the minimum of E_M. Application of the energy minimum principle leads to a set of equations for the pseudowavefunctions which are similar to but simpler than the Hartree–Fock equations. These equations contain pseudopotentials for which explicit expressions are derived. The possibility of replacing these pseudopotentials by simpler model potentials is discussed and the criteria for the selection of the model potential are outlined. (auth)

21235 FINITE PERTURBATION CALCULATIONS FOR THE STATIC DIPOLE POLARIZABILITIES OF THE FIRST-ROW ATOMS. Werner, H.; Meyer, W. (Institut für Physikalische Chemie, Johannes Gutenberg Universität, Mainz, Germany). Phys. Rev. A 13: No. 1, 13-16 (Jan 1976).

Static dipole polarizabilities are calculated from self-consistent-field and highly correlated wave functions for the ground states of the atoms Li through Ne. The correlation contributions to the polarizabilities are found to vary between -16% for Be and $+14\%$ for F. The polarizabilities as obtained from the coupled-electron-pair approximation are expected to be accurate to about 2%. (auth)

21236 A GROUP THEORETICAL APPROACH TO GEMINAL PRODUCT MATRIX ELEMENTS. Siems, W.F.; Poshusta, R.D. (Department of Chemistry, Washington State University, Pullman, Washington 99163). J. Chem. Phys. 64: No. 1, 6-26 (1 Jan 1976).

Expressions enabling systematic compilation of Hamiltonian and overlap matrix elements for an antisymmetrized multiterm geminal product trial function are derived, using double coset (DC) decompositions and subgroup adapted irreducible representations of the symmetric group, S_N. The trial function may describe an even electron atomic or molecular system in any total spin eigenstate, and the geminals may be nonorthogonal, have arbitrary permutational symmetry, and be explicit functions of interelectronic distance. A DC decomposition is used to factor out permutations not exchanging particle labels between geminals (elements of the interior pair group, S^n_2, $n\equiv N/2$). This reduces the sum over M permutations to a sum over DC generators. If the irreducible representation λ (S) of S_N is adapted to S^n_2 each geminal is projected into its singlet or triplet component. The DC generators are chosen such that each has the form QP, where Q permutes odd particle labels only and P is a permutation of geminals (element of the exterior pair group, S_n). With the aid of matrices called DC symbols an algorithm for these generators is derived, and used to find explicit sets for N=2, 4, 6, and 8. The N-electron Hamiltonian and overlap integrals arising with a particular DC generator QP are factored into products of smaller integrals, called cluster integrals, according to the cycle structure of Q. The cluster integrals are of only three main types—overlap, one-cluster energy, and two-cluster energy (analogs of orbital overlap, 1-electron, and 2-electron integrals) —and are further classified by order (number of geminals), geminal permutational symmetry, and in some cases pattern of connection. Matrix element compilation is systematic in that all N-electron integrals are products of a relatively small number of different types of cluster integral, and that N-electron integrals with similar factored forms are collected together in the summation. From counting the different cluster integrals required, it is concluded that a geminal product calculation not using orbital expansion is feasible only for systems with eight or less electrons. In some cases semiempirical calculations with correlated geminals might be considered, for the more complex cluster integrals (those of high order) are quite small for a system approximating a collection of localized electron pairs. The matrix element expressions are specialized for three cases—all geminals being singlets, strongly orthogonal geminals, and identical geminals. Comparison is made with a recently developed diagrammatical method. (auth)

21237 SELF-CONSISTENT FIELDS IN ATOMS. March, N. H. Oxford; Pergamon Press (1975). 242p.

The book is in two parts. In the first part the subject is dealt with in chapters entitled: central wave functions and angular momentum operators; concept of self-consistent field; Thomas-Fermi atom; energies of atoms and ions; other atomic properties; x-ray scattering and electron densities in atoms; electron exchange and Slater determinants; electron–electron correlation; relativistic effects in heavy atoms; the wave mechanics of an atom with a non-Coulomb central field; the calculation of atomic fields. In the second part of the book are reproduced the original papers in various aspects of the subject by D. R. Hartree, L. H. Thomas, E. Fermi, and J. C. Slater. (UK)

21238 CHARGE AND MOMENTUM DENSITY IN METALS AND ALLOYS. Cusack, S.; March, N. H. (Imperial Coll. of Science and Tech., London). Int. J. Quant. Chem., Symp.; No. 9, 481-496 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Following a brief summary of results on the charge density and one-body potential in the light metals Li and Be, the paper is concerned with two specific properties of random alloys, (1) the (integrated local) density of states [rho(rE)], the brackets denoting the random configurational average, and (2) the momentum distribution. For the disordered alpha brasses, the virtual crystal approximation works quite well for some Fermi surface properties, though it appears at first sight to do the configurational averaging in the wrong order. By constructing a periodic potential to yield the generalized partition function [C(rbeta)] of the random alloy (beta equals 1/k/sub B/T), where [rho(rE)] is the inverse Laplace transform of [C(r beta)/beta], some justification is given for the use of such averaging as in the virtual crystal approach. Finally, the momenta of electrons in metallic alloys are studied via two limiting models. First, for cases with charge transfer and localized screening by perturbed "molecular" or Bloch orbitals (e.g., LiMg) Friedel's Thomas–Fermi model for concentrated alloys is shown to lead to high-momentum components due to the localized screening charge. Compton scattering ought therefore to give direct information on such screening in an alloy like LiMg. An alternative scheme based on "atoms in crystals" is briefly sketched, and some experimental results on the Compton profile of TiNi alloys are referred to in connection with this latter model. (auth)

21239 QUANTUM THEORY OF RADIATIVE TRANSITION PHENOMENA. Langhoff, P. W.; Heffner, W. R. (Indiana Univ., Bloomington). Int. J. Quant. Chem., Symp.; No. 9, 461-470(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

An elementary account is given of the absorption and emission of radiation by molecules employing a particular formulation of Schroedinger theory which facilitates the treatment of radiative line widths and level shifts. The familiar Fermi golden rule for transition rates, the Rabi–Bloch–Siegert absorption profile, and the Weisskopf–Wigner approximation for spontaneous decay are obtained under appropriate conditions in the context of a common perspective. Comparisons are made with other recently devised perturbative and nonperturbative formulations of electromagnetic transition phenomena which correctly include radiative line widths and level shifts, and the importance of proper treatment of the normalization and phase of the Schroedinger wave function in this connection is emphasized. (auth)

21240 APPLICATIONS OF THE DIRAC–SLATER MODEL TO MOLECULES. Ellis, D. E. (Northwestern Univ., Evanston, IL); Rosen, A.; Walch, P. F. Int. J. Quant. Chem., Symp.; No. 9, 351-358(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Applications of the Dirac–Slater model to obtain relativistic energy levels and wave functions for molecules are reported. Results are presented for the uranyl ion UO_2^{2+}, calculated by a discrete-variational method using numerical free-atom basis functions. A simple moment polarized generalization of the Slater exchange potential is proposed for treating open-shell systems; results for a 5d atom are compared with corresponding nonrelativistic spin-polarized states. (auth)

21241 COMPARISON OF TFD AND X alpha METHODS FOR MOLECULES AND SOLIDS. Slater, J. C. (Univ. of Florida, Gainesville). Int. J. Quant. Chem., Symp.; No. 9, 7-21(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The Thomas–Fermi–Dirac (TFD) and multiple-scattering X alpha (MS-X alpha) methods are compared for single atoms and for molecules and solids. Both methods are derived from Hamiltonians by variation of the charge density or spin orbitals, respectively, and the Hamiltonians for the two methods differ only in the kinetic energy term. It is pointed out that the main errors in the TFD method arise from the statistical version of the kinetic energy term. The X alpha method, which uses the exact kinetic energy term, can be regarded as a modification of the TFD method which removes all the major errors in that method. The Coulomb energy and the exchange-correlation term are identical in both methods. By the example of the TFD method for the carbon atom the various features of both methods are illustrated, and it is pointed out that many features of the calculation of total energy by the X alpha method, as described by the overlapping-sphere approach, can be understood better by studying the same problem from the TFD point of view. (auth)

21242 LIMITATIONS OF ROBY'S THEOREM. Cusachs, L. C.; Aldrich, H. S.; Aiken, J. G.; Jonassen, H. B.; Wheelock, K. S. (Loyola Univ., New Orleans). Int. J. Quant. Chem., Symp.; No. 9, 265-267(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Roby's theorem establishes that, under certain conditions, electron interaction matrix elements over symmetrically orthogonalized (Loewdin) orbitals may be obtained from those over the ordinary nonorthogonal basis by simply discarding all integrals containing products of orbitals centered on different atoms (NDDO approximation). We present evidence of the existence of many important cases where the error of this approximation, in practice, varies so rapidly with internuclear distance as to constitute a serious problem. (auth)

21243 ENERGY WEIGHTED MAXIMUM OVERLAP IN MAGNETIC FIELDS. Applications to Electron Spin Resonance Problems. Dalgard, E.; Linderberg, J. (Aarhus Univ., Denmark). Int. J. Quant. Chem., Symp.; No. 9, 269-277(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Features of the energy weighted maximum overlap (EWMO) model in the presence of a homogeneous magnetic field are analyzed with the view of determining g tensors. London orbitals are used to ensure translational invariance of the results. Several radicals are studied and satisfactory agreement is found between calculated and observed g tensors. These results and previously published ones are used to discuss the possible structure of certain chlorine and bromine oxide radicals. (auth)

21244 CHARGES AND BOND ENERGIES IN THE ANALYSIS OF QUANTUM CHEMISTRY CALCULATIONS. Hall, G. G. (Univ. of Nottingham, Eng.). Int. J. Quant. Chem., Symp.; No. 9, 279-284(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

It is shown that a point charge model, supplemented by point dipoles and multipoles, can be defined for most molecular wave functions as a form of population analysis which has immediate physical significance. By analyzing the calculated total energies of a set of related molecules the concept of the bond energy of a heteropolar bond can be defined. A comparison between these and the corresponding quantities derived from experimental hydrogenation energies shows much better agreement than might have been expected from the correlation energies. These are two examples of the kind of theoretical analysis of ab initio calculations that is now urgently needed to obtain the maximum return from the computer investment. (auth)

21245 IONIZATION POTENTIALS AND CONDITIONAL AMPLITUDES. Hunter, G. (Univ. of Florida, Gainesville). Int. J. Quant. Chem., Symp.; No. 9, 311-315(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A procedure for deriving ionization potentials is presented based upon the factorization of a wave function into the product of a conditional amplitude and a one-electron marginal amplitude. In the asymptotic limit as one electron is removed, the conditional amplitude becomes the wave function of the residual positive ion, so that successive ionization potentials can be generated in sequence by the same procedure. (auth)

21246 SEMIQUANTITATIVE MODEL OF SPIN-ORBIT COUPLING IN DOUBLET STATES AND ITS APPLICATION TO THE PHOTOELECTRON SPECTRA OF DIATOMIC HALOGENS. Hall, M. B. (Adelphi Univ., Garden City, NY). Int. J. Quant. Chem., Symp.; No. 9, 237-243(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

An algorithm for a model of the spin-orbit coupling in doublet states of polyatomic molecules is presented. It is used to provide a complete and consistent interpretation of the photoelectron spectra of the diatomic halogens I_2, Br_2, ICl, and IBr. The success of the model in these systems and in some previously studied transition metal systems suggests that it may be of general utility to the experimentalist in the assignment and interpretation of the photoelectron spectra of molecules containing one or more heavy atoms.

21247 EXCITATION OPERATOR APPROACH TO LOCALIZED EXCITED STATES. Deutsch, P. W. (Battelle Columbus Labs., OH); Collins, T. C. Int. J. Quant. Chem., Symp.; No. 9, 213-220(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The OAO excitation operator previously developed to handle the electron–hole interaction in optical excitations is refined. A perturbative treatment of relaxation is developed and it is found that relaxation about a core hole must be treated at least by limited diagonalization. A simplified approach to electronic correlation is presented. Results for atomic beryllium are compared with experiment and theory. (auth)

21248 USE OF A LOCALIZED DESCRIPTION OF THE ELECTRONIC STRUCTURE OF SOLIDS. Cartling, B. G. (Massachusetts Inst. of Tech., Cambridge). Int. J. Quant. Chem., Symp.; No. 9, 117-121 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A localized description of the electronic structure of solids is discussed, where localized orbitals are defined as the eigenfunctions of the one-electron Hamiltonian for a finite cluster of atoms in a simulated crystalline environment. A few suggestions are provided on information to be extracted from such a model, restricting the information to be insensitive to choice of cluster and boundary conditions and convergent with increasing cluster size. (auth)

21249 POSITION DEPENDENCE OF THE EXCHANGE HOLE IN ATOMS AND IONS. Csavinszky, P. (Univ. of Maine, Orono). Int. J. Quant. Chem., Symp.; No. 9, 123-128 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

In the Hartree-Fock equations, as simplified by Slater, each electron is assumed to be acted upon by an exchange potential. The exchange potential, for an electron of a given spin, can be expressed in terms of the radius of the exchange hole surrounding the electron in question. This paper reports a simple calculation on the position dependence of the exchange hole radius in the Ne and Ar atoms, where there are equal numbers of spin-up and spin-down electrons, and in the Na atom, where the numbers of the spin-up and spin-down electrons differ by 1. (auth)

21250 MS-X alpha CALCULATIONS OF POLYHEDRAL BORON COMPOUNDS. Preston, H. J. T.; Kaufman, J. J.; Koski, W. S. (Johns Hopkins Univ., Baltimore). Int. J. Quant. Chem., Symp.; No. 9, 137-145 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

MS-X alpha calculations have been carried out for $B_6H_6^{-2}$, B_5H_9, and 1, 6-$B_4C_2H_6$. Even with the simple muffin-tin approximation, the agreement of the transition state orbital energies with the measured photoelectron spectral ionization potentials for B_5H_9 and 1,6-$B_4C_2H_6$ is as good or better than that found with previous ab initio minimum STO basis LCAO-MO-SCF calculations. The undesirable brittleness of the refractory borides is due to boron polyhedra being joined together in three-dimensional networks by unpaired outpointing electrons at the apices of the polyhedra. It is suggested that a way to ameliorate this brittleness would be to replace some of the boron atoms by carbons (or nitrogens or oxygens) to cut down on the outpointing unpaired electrons and thus to cut down on three dimensional network bonding. It is further hypothesized that such "carborides" or related congeneric species might also have an excellent possibility of being high-temperature superconductors. (auth)

21251 MULTICONFIGURATION METHOD FOR EXCITED STATES OF ATOMS AND MOLECULES. Grein, F.; Banerjee, A. (Univ. of New Brunswick, Fredericton). Int. J. Quant. Chem., Symp.; No. 9, 147-154 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A new method is presented by which the orthonormal orbital set of a multiconfiguration wave function can be optimized for an excited state of a given symmetry and spin, such that the calculated excited state energy remains an upper bound to the corresponding exact energy. The common difficulties of root flipping and poor convergence are avoided by isolating the desired root by a root-shifting mechanism. Model calculations on the lower ^2S states of Li and the ^1S states of Be demonstrate the capability and stability of this method. (auth)

21252 CHARGE DENSITIES AND TRANSITION DENSITIES FROM THE THEORY OF NON-CLOSED-SHELL STATES AND THEIR EXPERIMENTAL TESTS. Sinanoglu, O. (Yale Univ., New Haven). Int. J. Quant. Chem., Symp.; No. 9, 155-164 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

It is shown that the proper generalization of the Hartree–Fock wave function to non-closed-shell states is the charge wave function, psi/sub c/, introduced recently by Sinanoglu. This wave function contains all the specifically non-closed-shell type correlation effects which vanish in the closed-shell limit, that is, the internal and semi-internal correlations. The psi/sub c/ gives the "charge-like properties" like electric dipole, quadrupole moments, form factors, hyperfine constants, and the transition densities, hence the allowed and forbidden optical transition probabilities, generalized oscillator strengths, Born cross sections, etc., to good accuracy. The charge wave functions of various ground and excited states are calculated, and from them the above charge-like properties. Unlike the Hartree–Fock values which show large discrepancies, the charge wave function results agree very well with experiments. (auth)

21253 PATTERN CALCULUS FOR THE UNITARY GROUP APPROACH TO THE ELECTRONIC CORRELATION PROBLEM. Paldus, J. (Univ. of Waterloo, Ont.). Int. J. Quant. Chem., Symp.; No. 9, 165-174 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A pattern-type calculus is formulated enabling a very simple generation of the N-electron spin-symmetry adapted orthonormal basis for an arbitrary spin multiplet as well as an efficient calculation of the matrix representatives of the elementary raising (lowering) generators in such bases. A simple example illustrating this technique is also presented.

21254 SOME ASPECTS OF DIAGRAMMATIC PERTURBATION THEORY. Bartlett, R. J. (Pacific Northwest Labs., Richland, WA); Silver, D. M. Int. J. Quant. Chem., Symp.; No. 9, 183-198 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Many-body perturbation theory, or the linked cluster diagrammatic representation of Rayleigh-Schroedinger perturbation theory, is demonstrated to arise from the variational configuration interaction procedure by elementary considerations of Loewdin's partitioning approach to perturbation theory. As a consequence, variational upper bounds to the energy, which arise from the inclusion of some "unlinked" terms, may be obtained from odd-order MBPT calculations and are useful for certain applications. A brief discussion of low-order correlation diagrams for second-order properties is also presented. (auth)

21255 AMPLIFIERS INVOLVING TWO-PHOTON ENERGY-EXTRACTION SCHEMES. Carman, R. L. (Los Alamos Scientific Lab., NM). Phys. Rev., A; 12: No. 3, 1048-1061 (Sep 1975).

Amplifiers based on two-photon decay channels of inverted metastable species are examined from a rate-equation and practical-feasibility viewpoint. Approximate analytical solutions, within the rate-equation approximation, predict that resonant parametric generation coupled with anti-Stokes–stimulated Raman scattering (ASRS) is a strong competitor to straight two-photon emission. Expressions for initial growth rates indicate that large linear chromatic dispersion, proper linear absorptions, and resonant enhancements can initially favor two-photon emission, but that ASRS will ultimately dominate in most practical situations if inversion depletion does not occur early. For an amplifier based on degenerate two-photon processes, this situation has led to the proposal of running the system as an odd-harmonic generator, first extracting energy via two-photon emission followed by greater-than-100 percent conversion to the third, fifth, seventh, etc., harmonics. This type of amplifier response has important potential applications for laser-induced thermonuclear fusion as well as for the production of coherent vacuum-uv soft-x-ray systems. An examination of practical constraints provides further analytical relationships between various physical properties of prospective metastable species. Combining these results, several two-photon schemes are pointed out. Based on current technology, atomic iodine, which is inverted to the $^2P_{1/2}$ state, appears to be the best medium for experiments, but other materials, such as atomic oxygen, show greater promise if absolute population inversions of high-density material are created at high efficiency. (auth)

21256 THOMAS–FERMI-LIKE ANALYTIC INDEPENDENT PARTICLE MODEL FOR ATOMS AND IONS. Green, A. E. S.; Garvey, R. H.; Jackman, C. H. (Univ. of Florida, Gainesville). Int. J. Quant. Chem., Symp.; No. 9, 43-50 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The applicability of an independent particle model which was initiated with a particular two-parameter analytic fit to the Thomas–Fermi screening function is further extended. Using the ab initio procedure of Bass, Green, and Wood, the two parameters d and K of the model are determined for all atoms and ions with Z less than or equal to 36, thus extending the determination of Szydlik and Green. The calculated total energies are in excellent agreement with Hartree–Fock results. To a good accuracy K and 1/d may be represented as linear functions of Z – N where N is the total number of electrons and Z the nuclear charge. The slopes and intercepts of the K lines vary fairly smoothly with N, while those of the 1/d lines vary with N in a manner which reflects atomic shell structure. (auth)

21257 RELATIVISTIC EFFECTS IN THE THOMAS–FERMI ATOM. Waber, J. T.; Canfield, J. M. (Northwestern Univ., Evanston, IL). Int. J. Quant. Chem., Symp.; No. 9, 51-58(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Two methods of applying relativistic corrections to the Thomas–Fermi atom are considered, and numerical calculations are discussed. Radial charge distributions calculated from a relativistic Thomas–Fermi equation agree in gross form with those from more complicated self-consistent calculations. Energy eigenvalues for mercury, as determined from the relativistic Thomas–Fermi solution, are compared with other calculated and experimental values. (auth)

21258 MINIMUM PRINCIPLES FOR THE THOMAS–FERMI–DIRAC DENSITY. Goodisman, J.; Yonei, K. (Syracuse Univ., NY). Int. J. Quant. Chem., Symp.; No. 9, 59-66(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

For an atomic or molecular system we consider the evaluation of the Thomas–Fermi–Dirac energy functional using an electron density whose value and bounding surfaces differ by small amounts from those of the exact Thomas–Fermi–Dirac electron density. The resulting energy is shown necessarily to be higher than the true Thomas–Fermi–Dirac energy. If the displacement of the boundary is not small, the conclusion still holds as long as the boundary of the approximate density lies everywhere outside that of the exact density. (auth)

21259 DYNAMICAL EXTENSIONS OF THE THOMAS–FERMI THEORY. Lundqvist, S. (Chalmers Univ. of Tech., Goteborg). Int. J. Quant. Chem., Symp.; No. 9, 23-30(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The hydrodynamical approach is reviewed, considering the excitations of the electrons as small density oscillations around the ground state density. For high-frequency perturbations, which will induce plasma-type motions in the system, it is not an adequate procedure to describe the dynamics in terms of local changes in the static pressure. A formulation is proposed in which one retains the physical simplicity of the Thomas–Fermi approach in the treatment of the electrostatic forces but includes the quantum dynamics of the system in a way which is in principle exact within the linear response approximation. This formulation forms the basis for approximations at various levels. Applications to surface problems and to atomic systems are discussed briefly. (auth)

21260 CHEMICAL BINDING IN SMALL MOLECULES BY THE SPIN–DENSITY–FUNCTIONAL FORMALISM. Gunnarsson, O. (Chalmers Univ. of Tech., Goteborg); Johansson, P.; Lundqvist, S.; Lunqvist, B. I. Int. J. Quant. Chem., Symp.; No. 9, 89-93(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A brief review is given of some results within the spin-density-functional (SDF) formalism. The local-spin-density (LSD) approximation, that is, the approximation which is formally exact in the limit of slow and weak spatial variations, gives results of a useful accuracy for valence electrons in atoms and solids, and the accuracy for molecules may be illustrated by the hydrogen-molecule energy curves in the lowest ^{1}SIGMA$^+$/sub g/ and ^{3}SIGMA$^+$/sub u/ states being about 0.3 eV from the exact result. Good results are obtained for H_3^+, H_3, and H_3^-, too. Applications to He_2^+ and He_2^{2+} inform about the range of applicability of the approximation. Further, the new numerical method developed for these molecular applications allows an evaluation of the multiple-scattering X alpha method, showing shortcomings of both the potential and the multiple-scattering approach used in this method. It is argued that the SDF formalism within the LSD approximation is physically superior to the X alpha method and provides a simple and useful method for applications within a broad range, such as calculations on molecules and chemisorption systems. (auth)

21261 APPROXIMATE SCF MO THEORY OF MOLECULES BASED ON SLATER'S X alpha METHOD. Sambe, H. (Georgia Inst. of Tech., Atlanta). Int. J. Quant. Chem., Symp.; No. 9, 95-104(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A new approximate SCF MO theory is constructed for molecular systems based on the X alpha method. The proposed theory is suited especially for potential surface calculations. Atomic "core" is separated and no adjustable parameters appear in the theory. Many quantities in the theory can be determined by the undistorted atomic electron densities. Explicit expressions for the separation energy and the model potential are given. (auth)

21262 CALCULATION OF THE ENERGY STATES IN A GENERAL MOLECULAR POTENTIAL MODEL. A New MSW Approach. Scheire, L.; Phariseau, P. (Univ., Ghent). Int. J. Quant. Chem., Symp.; No. 9, 105-115(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A new MSW approach for the calculation of the energy states in a general molecular potential model is discussed. A general theory is presented where the difficulties arising from the matching problem across the arbitrary boundaries are avoided. The secular equation to determine the energy spectrum of the molecular or atomic cluster is obtained and the wave functions are calculated in all characteristic regions. (auth)

21263 CALCULATION OF CORRELATION ENERGY FOR MANY-ELECTRON ATOMS IN SEMICLASSICAL APPROXIMATION USING A DENSITY MATRIX. Kamel, M. A.; Labzovskii, L. N. Opt. Spectrosc. (USSR) (Engl. Transl.); 38: No. 2, 113-114(Feb 1975).

Translated from Opt. Spektrosk.; 38: No. 2, 201-205(Feb 1975).

In the framework of second order perturbation theory, a simple expression was obtained for the correlation energy of a many-electron atom in semiclassical approximation. The dependence of the correlation energy on the value of the total spin of the atom was also obtained. (2 figs.)

21264 ATOMIC CALCULATIONS USING PERTURBATION THEORY WITH A MODEL POTENTIAL. Manakov, N. L.; Ovsyannikov, V. D.; Rapoport, L. P. Opt. Spectrosc. (USSR) (Engl. Transl.); 38: No. 2, 115-117(Feb 1975).

Translated from Opt. Spektrosk.; 38: No. 2, 206-211(Feb 1975).

A method is proposed for calculating higher orders of perturbation theory for interaction of atoms with an electromagnetic field. It is based on using a model potential to describe the valence electron. Polarizabilities, sums of oscillator strengths S(–3), and hyperpolarizabilities are calculated for a number of atoms and ions. Good agreement of the results obtained here with the experiment and with other investigations is noted. (auth)

21265 BOUNDS TO TRANSITION INTEGRALS FOR THE HELIUM ISOELECTRIC SEQUENCE. Leopold, J. G. (Israel Atomic Energy Commission, Beersheba); Cohen, M. J. Phys., B (London); 8: No. 15, L369-L373(21 Oct 1975).

Bounds to the $1^1S \rightarrow 2^1P$ and $2^3S \rightarrow 2^3P$ transition integrals of the helium isoelectronic sequence have been calculated using a procedure described recently. The importance of the choice of expansion basis sets is emphasized. (auth)

21266 PERTURBATION THEORY IN CALCULATIONS OF ATOMIC ENERGY LEVELS. Ivanova, E. P.; Safronova, U. I. (Moscow Inst. of Spectroscopy). J. Phys., B (London); 8: No. 10, 1591-1602(11 Jul 1975).

On the basis of the field form of perturbation theory energy levels of atomic systems with numbers of electrons up to 10 are calculated. Configurations $1s^2 2s^{n_1} 2p^{n_2}$ (n_1 = 0 to 2, n_2 = 0 to 6) are considered. The coefficients ΔE_1, ΔE_2 in an energy expansion by powers of 1/Z are calculated. Hartree-Fock energies are also represented in the form of a Z-expansion, and the coefficients ΔE_1^{HF}, ΔE_2^{HF}, ΔE_3^{HF} of this expansion are computed. These calculations allow one to represent the correlation energy in the form of a Z-expansion. (auth)

21267 BEHAVIOR OF ATOMIC BOUND STATES IN VERY STRONG ELECTROMAGNETIC FIELDS. Pert, G. J. (Hull Univ., Eng.). J. Phys., B (London); 8: No. 10, L173-L178(11 Jul 1975).

A simple Green's function transformation is used to semi-classically describe the atomic wavefunction in very strong electromagnetic fields. It is concluded that a series of "quasi-stationary" states are formed, which only ionize slowly. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 21853.

21268 (AECL-5256, pp 41) PHONON DISPERSION IN SUPERFLUID HELIUM UNDER PRESSURE. Svensson, E. C.; Martel, P.; Woods, A. D. B. Oct 1975.
In Physics Division progress report, July 1 to September 30, 1975.

21269 (AECL-5256, pp 42) DISPERSION RELATION IN ^{4}He AT LARGE WAVE VECTORS. Smith, A. J.; Martel, P.; Stirling, W. G.; Woods, A. D. B. Oct 1975.
In Physics Division progress report, July 1 to September 30, 1975.

21270 MULTIPARTICLE CORRELATED WAVE FUNCTION FOR BOSE SYSTEMS. Chakravarty, S.; Woo, C. (Department of Physics, Northwestern University, Evanston, Illinois 60201). Phys. Rev. B 13: No. 1, 105-111 (1 Jan 1976).
A correlated wave function for interacting Bose systems with correlation factors up to five-particle parts is suggested. The vehicle used is an analysis for the weakly interacting Bose gas by a new method. Terms up to $O(\lambda^2)$, where λ measures the strength of the interaction, for the two-particle (Jastrow) factor and the three-particle factor, as well as ground-state energy up to $O(\lambda^4)$, are shown to agree with exact results obtained previously with other methods. New results include *all* multiparticle correlation factors up to $O(\lambda^4)$. The wave function will be most useful for analytically soluble model systems, and more importantly, for Monte Carlo or molecular-dynamics calculations dealing with realistic systems such as superfluid ^{4}He. (auth)

21271 *f*-WAVE PAIRING OF PARALLEL SPINS NEAR THE TRANSITION TEMPERATURE. Mermin, N.D. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). Phys. Rev. B 13: No. 1, 112-120 (1 Jan 1976).
A partial solution is found to the problem of minimizing the general fourth-order Ginzburg-Landau free energy for triplet *f*-wave pairing in which only a single spin population is paired. The weak-coupling BCS free energy is found to lie in the interior of a region of the space of fourth-order parameters throughout which the solution of lowest free energy gives no Leggett NMR shift, in contrast to observed behavior in the A_1 phase of superfluid ^{3}He. The solutions in the regions of parameter space that border on the weak-coupling region are also examined. (auth)

21272 NONLINEAR SPIN DYNAMICS IN SUPERFLUID ^{3}He. Combescot, R. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). Phys. Rev. B 13: No. 1, 126-139 (1 Jan 1976).
A previous approach to spin dynamics in superfluid ^{3}He is generalized to the nonlinear regime, where the direction of the order parameter has large deviations from its equilibrium position. The results are used to study the hydrodynamic regime, to derive an equation for the nonlinear regime in the ringing experiments, and to consider the nonlinear effects arising in spin-echo experiments for small tipping angles. The results for the NMR linewidths (in the linear regime) are compared with a very recent work of Leggett and Takagi. Finally, the behavior of these linewidths is investigated at low temperature, where the hydrodynamic assumption $\omega\tau \ll 1$ is no longer valid. (auth)

21273 SECOND-SOUND VELOCITY IN ROTATING SUPERFLUID HELIUM. Vidal, F. (Groupe de Physique des Solides de l'Ecole Normale Supérieure, 24, rue Lhomond, 75231 Paris, Cedex 05, France); Lhuillier, D. Phys. Rev. B 13: No. 1, 148-168 (1 Jan 1976).
We have investigated the second-sound velocity u_2 in rotating superfluid helium by observing the resonant modes of a rotating cavity. We have discovered an unexpected decrease in u_2. This effect has been measured in different second-sound resonators, and as a function of the second-sound frequency ($10^3 \leqslant \omega \leqslant 10^5$ rad/sec), the He II temperature ($1.3 \leqslant T \leqslant 2.1$ °K), and the angular velocity of rotation ($\Omega \leqslant 8$ rad/sec). We have found that the decease in u_2 is proportional to Ω and is inversely proportional to the second-sound frequency. We show that this decrease may be explained within the the two-fluid model of Landau and Khalatnikov if we suppose the existence of a thermodynamic coupling between the dissipative heat flux and the mutual-friction force. The principal cause of this coupling, we suggest, is entropy transport by the moving vortices. We discuss the origin of this entropy transport using the idea, suggested by Hall and Vinen, of the moving vortices dragging the normal fluid. The theoretical expression we obtain for the decrease of u_2 in rotating helium is in reasonable agreement with our experimental results. We propose that this effect can be considered as the analog in rotating He II of the thermomagnetic effect in the mixed state of type-II superconductors. (auth)

21274 DENSITY PROFILE OF A QUANTIZED VORTEX LINE IN SUPERFLUID HELIUM-4. Harper, J. H. Denton, TX; North Texas State Univ. (1975). 184p. University Microfilms Order No. 75-24,171.
Thesis (Ph. D.).
The density amplitude of an isolated quantum vortex line in superfluid ^{4}He is calculated using a generalized Gross–Pitaevskii (G–P) equation. The generalized G–P equation for the order parameter extends the usual mean-field approach by replacing the interatomic potential in the ordinary G–P equation by a local, static T matrix, which takes correlations between the particles into account. The T matrix is a sum of ladder diagrams appearing in a diagrammatic expansion of the mean field term in an exact equation for the order parameter. It is an effective interaction which is much softer than the realistic interatomic Morse dipole-dipole potential from which it is calculated. A numerical solution of the generalized G–P equation is required since it is a nonlinear integro-differential equation with infinite limits. For the energy denominator in the T matrix equation, a free-particle spectrum and the observed phonon-roton spectrum are each used. For the fraction of particles in the zero-momentum state (Bose–Einstein condensate) which enters the equation, both a theoretical value of 0.1 and an experimental value of 0.024 are used. The chemical potential is adjusted so that the density as a function of distance from the vortex core approaches the bulk density asymptotically. Solutions of the generalized G–P equation are not very dependent on the choice of energy denominator or condensate fraction. The density profile is a monotonically increasing function of the distance from the vortex core. The core radius, defined to be the distance to half the bulk density, varies from 3.7 A to 4.7 A, which is over three times the experimental value of 1.14 A at absolute zero. (Diss. Abstr. Int., B)

21275 EFFECT OF BUOYANCY ON DISPERSION OF MATTER IN MAGNETOHYDRODYNAMIC FLOW BETWEEN TWO PARALLEL PLATES. Erdogan, M. E. (Tech. Univ. of Istanbul). Istanbul Tek. Univ. Bul.; 28: No. 1, 1-20(1975).
The effect of buoyancy on the dispersion of soluble matter through electrically conducting fluid which flows between two parallel plates in the presence of a transverse magnetic field is described. It is shown that the concentration flux across a plane moving with the mean speed of the flow, which provides a measure for longitudinal dispersion, depends on the Hartmann number, M, and the ratio of the Grashof number to the Reynolds number, G/R. It is found that, for a given G/R, when M increases, the concentration flux decreases, and for a given M, when the ratio G/R increases, the flux increases. Furthermore, a nonlinear one-dimensional diffusion equation satisfied by the mean concentration is obtained, and for large values of G/R a solution is given. (12 figures) (auth)

21276 THERMODYNAMIC PRESSURE IN SUPERFLUID HELIUM AND ITS IMPLICATIONS FOR THE PHONON DISPERSION CURVE. Menard, A. R. III. Gainesville, FL; Univ. of Florida (1974). 90p. University Microfilms Order No. 75-19,364.
Thesis (Ph. D.).
The thermodynamic pressure of superfluid ^{4}He, for seven densities from near saturated vapor pressure to 11 atm., has been measured from 0.4 K to 1 K, using a capacitive strain gauge. A comparison of these measurements with calculations for the pressure, based on the phonon-roton model for superfluid helium, led to the conclusion that anomalous phonon dispersion exists in helium at low densities. The magnitude of the anomalous dispersion is in good agreement with that deduced from specific heat measurements. The conjecture of a quadratic term in the expression for the dispersion curve does not agree with these data. Contributions to the pressure not accounted for by phonons and rotons were observed. These contributions, probably maxons, increased in magnitude and became noticeable at a lower temperature as the density was increased. (Diss. Abstr. Int., B)

21277 NONLINEAR INTERACTION OF MAGNETIC FIELD AND CONVECTION. Busse, F. H. (Univ. of California, Los Angeles). J. Fluid Mech.; 71: No. 1, 193-226(9 Sep 1975).
The interaction between convection in a horizontal fluid layer heated from below and an ambient vertical magnetic field is considered. The analysis is based on the Boussinesq equations for two-dimensional convection rolls and the assumption that the amplitude A of the convection and the Chandrasekhar number Q are small. It is found that the magnetic energy is amplified by a factor of order R_m^4, where R_m is the magnetic Reynolds number. The ratio be-

tween the magnetic and kinetic energies can reach values much larger than unity. Although the magnetic field always inhibits convection, this influence decreases with increasing amplitude of convection. Thus finite amplitude onset of steady convection becomes possible at Rayleigh numbers considerably below the values predicted by linear theory. (auth)

21278 OVERSTABLE HYDROMAGNETIC CONVECTION IN A ROTATING FLUID LAYER. Eltayeb, I. A. (Khartoum Univ., Sudan). J. Fluid Mech.; 71: No. 1, 161-179(9 Sep 1975).

The effect of the simultaneous action of a uniform magnetic field and a uniform angular velocity on the linear stability of the Benard layer to time-dependent convective motions is examined in the Boussinesq approximation. Four models, characterized by the relative directions of the magnetic field, angular velocity and gravitational force, are discussed under a variety of boundary conditions. Apart from a few cases, the treatment applies when the Taylor number and the Chandrasekhar number (the square of the Hartmann number) are large. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 21346 and 21349.

21279 (JINR-D1-5969, pp 249-279) PROGRAM OF EXPERIMENTAL STUDIES OF THE HIGH ENERGY LABORATORY OF JINR AND ITS FUTURE DEVELOPMENT. Kuznetsov, A. A. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21280 (JINR-D1-5969, pp 321-330) INDEX PROGRAM, A VALUABLE TOOL IN PROCESSING EXPERIMENTS IN HIGH ENERGY PHYSICS. Kaufmann, H. H.; Klugow, J. (Institut fuer Hochenergiephysik, Berlin). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21281 (LBL-4277) PHYSICS DIVISION ANNUAL REPORTS, 1 JULY 1972–31 DECEMBER 1974. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1974. Contract W-7405-eng-48. 109p. Dep. NTIS $6.00.

The research of the staff members of the Physics Division of Lawrence Berkeley Laboratory is presented in a descriptive fashion. Extensive lists of publications are included. The presentation is arranged as follows: high-energy physics (experimental physics, Particle Data Center, theoretical physics), nuclear science (heavy-ion research; nuclear structure studies that use mesons; atomic and molecular structure studies with mesons as probe particles; hadronic decay processes; interactions of light nuclei, protons, and antiprotons; collective models of heavy nuclei), molecular science, instrumentation development, data handling, and mathematics and computing (computer science, applied mathematics research). The experimental high-energy physics program dealt with such subjects as the discovery of the psi particles, pp and Kp interactions, antiparticles and hyperons, electromagnetic and weak interactions, lepton-induced reactions, astrophysics and cosmic ray research, and archaeology. (RWR)

21282 THEORIES AND EXPERIMENTS IN HIGH-ENERGY PHYSICS. Proceedings of the Orbis Scientiae Held at Coral Gables, Florida, January 20–24, 1975. Perlmutter, A.; Widmayer, S. M. (eds.). Studies in the Natural Sciences, Volume 9. New York; Plenum Publishing Corporation (1975). 494p. (CONF-750110-P1).

The conference included 16 papers. Separate abstracts were prepared for 12 papers. Three of these abstracts also appear in ERA. Three papers appeared previously in NSA. For abstracts of these papers see CONF-750110-P1. (JFP)

For abstracts of individual papers see: 21013, 21054, 21285, 21343, 21363, 21422, 21473–21476, 21495, and 21915.

Electromagnetic

Refer also to abstract 21093.

21283 (JINR-D1-5969, pp 231-242) NEUTRAL DECAY MODES OF η MESONS. Strugal'skii, Z. S.; Gemeshi, T.; Ivanovskaya, I. A.; Kanarek, T.; Krasnovskii, Sh.; Okhrimenko, L. S.; Pinter, D.; Yablonskii, Z. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21284 EXPERIMENTAL TEST OF CHARGE CONSERVATION AND THE STABILITY OF THE ELECTRON. Steinberg, R.I.; Kwiatkowski, K.; Maenhaut, W.; Wall, N.S. (University of Maryland, College Park, Maryland 20742). Phys. Rev. D 12: No. 9, 2582-2586 (1 Nov 1975).

A new experimental lower limit of 5.3×10^{21} years for the mean lifetime of the electron for decay into nonionizing particles is reported. A finite value for this lifetime would have implied a breakdown of the law of charge conservation. The experimental technique consists of a search for the internally-absorbed 11.1-keV x-ray and Auger-electron cascade which would follow the decay of a *K*-shell electron in a germanium atom in a high-resolution Ge(Li) detector. (auth)

21285 ELECTRON–POSITRON INCLUSIVE HADRON REACTIONS. Barnett, B. A. (Univ. of Maryland, College Park); Atwood, T.; Zorn, G. pp 115-130 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

Some of the preliminary measurements for performing an experiment on e^+e^- interactions are discussed. This experiment was predominantly a single-arm magnetic spectrometer for measuring e^+e^- inclusive cross sections. (JFP)

Weak

21286 (JINR-D1-5969, pp 201-230) VIOLATION OF COMBINED PARITY IN DECAYS OF K^0 MESONS. Budagov, Yu. A. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21287 EXPERIMENTAL STUDY OF THE ENERGY SPECTRUM OF THE π^+ IN $K^+ \to \pi^+\pi^0\pi^0$ DECAY. Sheaff, M. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. D 12: No. 9, 2570-2581 (1 Nov 1975).

A sample of 5635 π^+ with kinetic energies between 8 and 50 MeV was obtained from $K^+ \to \pi^+\pi^0\pi^0$ decays in the ANL-Michigan 40-in. heavy liquid bubble chamber filled with propane. For these the energy dependence was well described by a linear spectrum of the form $|M|^2 = 1 + g[(s_3 - s_0)/m^2_{\pi+}]$, where $g = 0.602 \pm 0.021$. No evidence was found for a quadratic term significantly different from 0. When the five conventional test quantities for the isospin selection rules were formed using the value of g from this experiment and current world averages for the other $K \to 3\pi$ decay parameters, it was found that there was significant evidence for $|\Delta I| = 3/2$ amplitudes into both $I = 2$ and $I = 1$ final states. These experimental values are in good agreement with theoretical predictions for them obtained in models which satisfy the current-algebra relation at the soft-pion points and include $|\Delta I| = 3/2$ as well as $|\Delta I| = 1/2$ amplitudes. (auth)

Strong (Baryon-induced)

Refer also to abstract 21478.

21288 (ANL/HEP-CP-75-58, pp 172-176) SEARCH FOR STRUCTURES IN anti pp CROSS SECTIONS IN THE 1910 to 1944 MeV MASS REGION. Montanet, L. (CERN, Geneva). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The anti pp total cross section was measured from 1910 to 1944 MeV with a mass resolution of approximately +-2 MeV. No fine structure was observed with GAMMA sigma above the statistical limit of 40 MeV mb. The partial cross section of anti pp annihilation, elastic scattering and topological cross sections are also presented. (auth)

21289 (ANL/HEP-CP-75-58, pp 177-182) STUDY OF ANTINEUTRON ANNIHILATIONS AT LOW ENERGY. Reeder, D. D. (Univ. of Wisconsin, Madison). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The results of a total cross section measurement for the reactions anti np and anti pn are plotted. These results indicate that the annihilation amplitudes are predominantly I equals 1 at low energy. The S-wave unitarity limit is shown, and the data support the conclusion drawn from anti pp data that even at the lowest momenta P-wave and higher waves are very important. The technique of using antineutrons to study very low energy antineutrons to study very low energy antinucleon interactions is demonstrated to be feasible. (JFP)

21290 (ANL/HEP-CP-75-58, pp 183-192) BNL MULTI-PARTICLE SPECTROMETER (MPS) PROGRAM. Love, W. A. (Brookhaven National Lab., Upton, NY). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The design and operation of the BNL multiparticle spectrometer are described. Also a formation experiment anti pp yields n/sub c/ yields final state was studied at 3.7 to 4.2 GeV/c tuning the total cm energy of the anti pp system to lie near the just below the J mass to search for the existence of a narrow peak (J/sup PC/ equals O/sup -+/, GAMMA nu several MeV). No outstanding peak is seen, but an approximate cross section limit is given in the region of a few microbarns. There is a clear K^0 signal. Also a plot of the effective mass and missing mass for events with two neutral K's produced by 8.7-GeV/c pi^- on hydrogen is given. (JFP)

21291 (ANL/HEP-CP-75-58, pp 318-329) STUDY OF A HIGH MASS DELTA^{++} STATE PRODUCED IN ASSOCIATION WITH THE rho, omega, AND K*(890) RESONANCES. Eisner, R. L. (Case Western Reserve Univ., Cleveland). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Data is presented from large statistics pi^+p (7.1 GeV/c) and K^+p (12.0 GeV/c) experiments which give strong evidence for production of a high mass pi^+p state. Detailed properties of this resonance are presented, and its production mechanism compared with that of the corresponding DELTA(1238) reactions. (auth)

21292 (ANL/HEP-CP-75-58, pp 352-357) REMARKS ON THE STATUS OF THE Z_1*. Steinberg, P. H. (Univ. of Maryland, College Park). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The discussion of the status of the Z_1* covers the substantial improvement in the differential cross section data for K^+p elastic scattering and an improved energy dependent analysis based on the K-matrix formalism, which in order to fit the data, requires a P/sub $3/2$/-resonance pole. (JFP)

21293 (ANL/HEP-CP-75-58, pp 358-367) NEW RESULTS ON XI* (1820) AND SIGMA (1660). Hemingway, R. J. (CERN, Geneva). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Data from the K^-p experiment which are relevant to the XI* (1820) and SIGMA (1660) resonances are presented. Included are decay branching ratios and cross sections and various particle properties. (JFP)

21294 (ANL/HEP-CP-75-58, pp 368-381) CASCADES IN THE TWELVE-FOOT BUBBLE CHAMBER. Morris, W.; Oh, B. Y.; Parker, D. L.; Smith, G. A.; Whitmore, J. (Michigan State Univ., East Lansing). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The results of K^-p interactions at 6.5 GeV/c are reported including cross sections for bubble chamber systematics, partial data on OMEGA$^-$ production, prospects for a high statistics OMEGA$^-$ experiment, and preliminary data on the dynamics of K/sub S/^{0}, LAMBDA^0, SIGMA$^+$, SIGMA$^-$, XI$^-$ production and the XI pi pi mass spectrum. (JFP)

21295 (CRN/HE-75-7) STUDY OF CHARGED MULTIPLICITY DISTRIBUTIONS IN $\bar{p}n$ INTERACTIONS AT 5.55, 9.3, AND 14.6 GeV/c. Fridman, A.; Gerber, J. P.; Juillot, P. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 29p. Dep. NTIS (US Sales Only) $4.00.

Based on three bubble chamber experiments carried out at Argonne (5.55 GeV/c), CERN (9.3 GeV/c) and Brookhaven (14.6 GeV/c) a study of multiplicity distributions obtained from $\bar{p}n$ interactions is presented. Only events having a visible track stopping in the chamber were used for the present analysis thus allowing to extract easily the coherent reactions from the data. The topological cross sections as well as various statistical moments obtained from the charged multiplicities are studied as functions of the incident momentum. Some comparison between results and $\bar{p}p$ and pp data is made. (auth)

21296 (CRN/HE-75-12) COHERENT PRODUCTION FEATURES IN dp INTERACTIONS AT 11.9 GeV/c. Braun, H.; Brick, D.; Fridman, J. P. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 13p. Dep. NTIS (US Sales Only) $3.50.

The two-pion production in coherent dp reactions is studied. The resonance production as well as the d* effect and the fragmentation processes are discussed. The present results are compared with available coherent $\bar{p}d$ data. (auth)

21297 (IS-T-705) PROTON-PROTON INTERACTIONS AT 200 AND 300 GeV/c. Ogino, F. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 155p. Dep. NTIS $6.75.

Thesis. Submitted to Iowa State Univ.

The reactions pp yields pp pi^+pi^- and pp yields pp $pi^+pi^-pi^+pi^-$ at 200 and 300 GeV/c were investigated using the Fermilab 30-inch hydrogen bubble chamber and downstream wide-gap spark chambers. This analysis is based upon approximately 9500 4-pronged and 6-pronged events. The cross sections were consistent with pomeron dominance for these reactions. The final state pp pi^+pi^- is dominated by single diffractive dissociation, whose features are quite similar to those observed at low energy. A strong signal for double excitation was seen in the pp $pi^+pi^-pi^+pi^-$ final state and pomeron factorization was found to be satisfied. In the pp pi^+pi^- final state, 66 events passed the criterion of double pomeron exchange defined by D. M. Chew. However, these events were found to be severely contaminated by diffractive events. The two-particle exclusive azimuthal correlations agreed well with the prediction of a photostatistical model. (auth)

21298 (JINR-D1-5969, pp 3-22) ELASTIC SCATTERING OF NUCLEONS BY NUCLEONS IN THE REGION OF SYNCHROCYCLOTRON ENERGY. Kazarinov, Yu. M. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21299 (JINR-D1-5969, pp 31-74) INELASTIC NEUTRON-PROTON INTERACTIONS AT ENERGIES ABOVE 1 GeV. Troyan, Yu. A. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21300 (JINR-D1-5969, pp 82-86) INELASTIC COLLISIONS OF DEUTERONS WITH MOMENTUM OF 2.43 GeV/c WITH THE ATOMIC NUCLEI OF PHOTOEMULSIONS. Loiova, M.; Silesh, E.; Tuchek, I. (Shafarik Univ., Koshitse, USSR). 1971. (In Russian)

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21301 (JINR-D1-5969, pp 280-290) RECENT EXPERIMENTS WITH THE LOW MOMENTUM BEAM FROM THE CERN PROTON SYNCHROTRON. Piekarz, J. (Univ., Warsaw). 1971.

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

Recent experiments performed with the low momentum beam are described including stopping K^- mesons and antiprotons. A description of the beam, experiments on x-ray spectra accompanying the stopping of a K^- mesons, hyperons, and antiprotons in various materials, and hypermuclear spectroscopy are discussed. (JFP)

21302 FURTHER SEARCH FOR MASSIVE LONG-LIVED PARTICLES PRODUCED BY 400-GeV PROTONS. Frankel, S.; Frati, W.; Resvanis, L.K.; Yang, W. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Nezrick, F. Phys. Rev. D 12: No. 9, 2561-2564 (1 Nov 1975).

We report the negative result of a search for the decay products of long-lived particles having lifetimes in the range 50 milliseconds to 10 hours. The upper limit for the "cross section for production and capture" of such particles in a 33-cm aluminum target irradiated with 400-GeV protons is set at less than 10^{-36} cm^2. (auth) .

21303 MEASUREMENT OF THE SPIN-SPIN CORRELATION PARAMETER C_{NN} IN PROTON-PROTON SCATTERING AT 6 GeV/c. Hicks, G.; Miller, D.; Wilson, C. (Physics Department, Northwestern University, Evanston, Illinois 60201); Bridges, D.; Giese, R.; Hill, D.; Miller, R.; Nield, K.; Rynes, P.; Sandler, B.; Yokosawa, A. Phys. Rev. D 12: No. 9, 2594-2596 (1 Nov 1975).

As part of a program to determine proton-proton elastic-scattering amplitudes, we have measured the spin-spin correlation parameter C_{NN} at 6 GeV/c. Measurements were made over the $|t|$ range of 0.08 to

1.4 (GeV/c)^2 using a polarized beam and a polarized target at the Argonne National Laboratory Zero Gradient Synchrotron. (auth)

21304 PION DISTRIBUTIONS IN HIGHLY INELASTIC $pp \rightarrow p\pi X$ AT 28.5 GeV/c AND COMPARISONS WITH $ep \rightarrow e\pi X$. Anderson, E.W.; Clifford, T.S.; Lazarus, E.; Schreiner, W.N.; Schüberlin, P.; Turkot, F. (Brookhaven National Laboratory, Upton, New York 11973); Gutay, L.J.; Collins, G.B.; Ficenec, J.R.; Stringfellow, B.C. Phys. Rev. D 12: No. 11, 3375-3385 (1 Dec 1975).

We have measured the π^- yield in $pp \rightarrow p\pi^- X$ relative to the cross section for $pp \rightarrow p +$ MM at 28.5 GeV/c. The pion distributions are parameterized in terms of x, p_t^2, and ϕ in the rest frame of the missing mass, MM. The distributions are compared with the corresponding electroproduction case for $-0.1 < x < 0.6$ at the same missing mass and four-momentum transfer to the scattered beam particle. We find striking similarities: (1) The ϕ distributions are flat for the proton case as in electroproduction, (2) the slopes of the transverse momentum distributions are the same as in electroproduction, and (3) the x distributions have the same shape as in electroproduction. (auth)

21305 MEASUREMENT OF THE DEPOLARIZATION PARAMETER IN ELASTIC PROTON-PROTON SCATTERING AT 3 AND 6 GeV/c. Abshire, G.W.; Bryant, G.W.; Corcoran, M.; Crittenden, R.R.; Gray, S.W.; Heinz, R.M.; Hendry, A.W.; Neal, H.A.; Rust, D.R. (Department of Physics, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 12: No. 11, 3393-3398 (1 Dec 1975).

Results are presented from an experiment designed to make the first systematic study of the depolarization parameter in elastic proton-proton scattering at high energies. Measurements were made at 3.0 and 6.0 GeV/c at $|t|$ values extending to 1.7 (GeV/c)^2 at the higher momentum. A high-intensity unpolarized proton beam was incident on a polarized proton target and the polarization of the elastically scattered recoil protons was determined with a carbon analyzer. The results are discussed in the framework of optical and exchange models. (auth)

21306 PROTON-DEUTERON ELASTIC SCATTERING AT SMALL MOMENTUM TRANSFER FROM 50 TO 400 GeV/c. Akimov, Y.; Golovanov, L.; Mukhin, S.; Sandacz, A.; Takhtamyshev, G.; Tsarev, V. (Joint Institute for Nuclear Research, Dubna, USSR); Malamud, E.; Yamada, R.; Zimmerman, P.D.; Cool, R.; Goulianos, K.; Sticker, H.; Gross, D.; Melissinos, A.; Nitz, D.; Olsen, S. Phys. Rev. D 12: No. 11, 3399-3413 (1 Dec 1975).

Proton-deuteron elastic scattering has been measured in the four-momentum transfer squared region $0.013 < |t| < 0.14$ (GeV/c)^2 and for incident proton beam momenta from 50 to 400 GeV/c. The data can be fitted with the Bethe interference formula. We observe shrinkage of the diffraction cone with increasing energy equal to (0.94 ± 0.04) ln(s/1 GeV^2) (GeV/c)$^{-2}$. This shrinkage is greater than that observed in pp elastic scattering. The ratio of the elastic to the total cross section is approximately 0.1 and independent of energy above $\sim$ 150 GeV. In order to extract information on pn scattering we fit our data using the Glauber approach and a form factor which is the sum of exponentials. The values we obtain for the slope parameter in pn scattering are sensitive to the details of the inelastic double-scattering term. (auth)

21307 STUDY OF CHARGED MULTIPLICITY DISTRIBUTIONS IN $\bar{p}n$ INTERACTIONS AT 5.55, 9.3, AND 14.6 GeV/c. Fridman, A.; Gerber, J.; Juillot, P.; Michalon, A.; Michalon-Mentzer, M.; Voltolini, C. (Centre de Recherches Nucléaires de Strasbourg, Strasbourg, France); Plano, R.J.; Sheng, A.P.; Brucker, E.B.; Koller, E.L.; Raths, O.; Stamer, P.E.; Taylor, S.; Hunt, W.; Malko, J.A.; Robinson, D.K. Phys. Rev. D 12: No. 11, 3414-3423 (1 Dec 1975).

We present a study of multiplicity distributions obtained from $\bar{p}n$ interactions based on three bubble chamber experiments carried out at Argonne (5.55 GeV/c), CERN (9.3 GeV/c), and Brookhaven (14.6 GeV/c). Only events having a visible track stopping in the chamber were used for the present analysis, thus allowing us to extract easily the coherent reactions from our data. The topological cross sections as well as various statistical moments obtained from the charged multiplicities are studied as functions of the incident momentum. Some comparison between our results and $\bar{p}p$ and pp data is made. (auth)

21308 DIFFRACTION DISSOCIATION OF NUCLEONS IN dp INTERACTIONS AT 25 GeV/c. Cooper, J. W. Ann Arbor, MI; Univ. of Michigan (1975). 208p. University Microfilms Order No. 75-29,196.

Thesis (Ph. D.).

The reaction dp yields dp pi$^+$pi$^-$ was observed in a BNL 80-inch bubble chamber exposure at 25 GeV/c incident deuteron momentum. This reaction allows no exchange of isospin between beam and target particles and therefore may approximate pure diffractive dissociation at this energy. When the t/sub min/ effect is taken into account, the cross section for this reaction appears to approach an energy independent value of approximately 0.5 mb. Evidence is found for the charge exchange reaction np yields p (p pi$^-$). In this process the (p pi$^-$) system shows evidence for DELTA^0 (1236) and N*(1520) production. (Diss. Abstr. Int., B)

Strong (Meson-induced)

Refer also to abstracts 20325 and 21813.

21309 (AECD/EP-30) PROBABLE EXAMPLE OF A $^{14}_{\Lambda}$C-HYPERNUCLEUS. Mondal, A. S.; Basak, A. K.; Kasim, M. M.; Husain, A. (Atomic Energy Centre, Dacca (Bangladesh)). Apr 1975. 11p. Dep. NTIS (US Sales Only) $4.50.

In a sample of 493 hyperfragments produced in the interactions of 3.0 GeV/c K$^-$ mesons with emulsion nuclei a probable example of a $^{14}_{\Lambda}$C hypernucleus has been found with binding energy B_Λ = (13.1 ± 0.5) MeV. (2 tables) (auth)

21310 (ANL/HEP-CP-75-58, pp 19-27) SEARCH FOR 1$^+$ AND 0$^+$ STATES IN pi$^-$p. Stanton, N. R. (Ohio State Univ., Columbus). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The reactions pi$^-$p yields pi$^+$pi$^-$pi^{0}n and pi$^-$p yields pi$^+$pi$^-$pi^{0}n are studied with high statistics at 6 and 8.5 GeV/c. The omega, eta, and rho$^-$ were observed. Cross sections are also discussed and scatter plots and mass spectra are shown. (JFP)

21311 (ANL/HEP-CP-75-58, pp 64-74) RECENT RESULTS FROM THE CERN-MPI SPECTROMETER. Hyams, B. (CERN, Geneva). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Results are presented from preliminary data on missing mass and polarization in pi$^-$p yields n pi$^+$pi$^-$ reactions off a transversely polarized target and pi$^-$p yields nK$^+$K$^-$ reactions at 18.4 GeV/c establishing a spin 4$^+$ resonance, for which quantum numbers are found. (JFP)

21312 (ANL/HEP-CP-75-58, pp 75-87) K$^-$K$^+$ AND pi$^-$pi$^+$ PRODUCTION IN K$^-$p INTERACTIONS AT 13 GeV. Brandenburg, G. W. (Massachusetts Inst. of Tech., Cambridge). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The discussion of K$^+$K$^-$ and pi$^+$pi$^-$ production in K$^-$p interactions at 13 GeV includes the production of phi and rho^0 mesons, rho^0 – omega interference, S* production, and the omega yields pi$^+$pi$^-$ branching ratio. (JFP)

21313 (ANL/HEP-CP-75-58, pp 88-95) ADVENTURES WITH THE K anti K SYSTEM. Cason, N. M. (Univ. of Notre Dame, IN). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The status of the new generation of K anti K experiments is reviewed. The reactions discussed are of the type pi N yields K anti KN. The general characteristics of the K anti K system which make it interesting and unique, the results of the first generation of experiments, and finally the status of the current experiments and some plans for future analyses. (JFP)

21314 (ANL/HEP-CP-75-58, pp 125-129) EXPERIMENTAL SEARCH FOR ERICSON FLUCTUATIONS AT CERN. Schmidt, F. H. (Univ. of Washington, Seattle). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Cross section difference measurements are discussed for pi$^+$p and pi$^-$p elastic interactions. It is believed that there is some positive evidence for Ericson fluctuations in pi$^+$p elastic scattering. (JFP)

21315 (ANL/HEP-CP-75-58, pp 130-136) SEARCH FOR ERICSON FLUCTUATIONS IN pi$^+$p SCATTERING AT 3.7 AND 7.1 GeV/c. Michael, W. (Univ. of California, Berkeley). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Data on pi$^+$p elastic scattering, obtained from two high statistics bubble chamber exposures at 3.7 and 7.1 GeV/c beam momentum, were examined for Ericson fluctuations. No evidence for such fluctuations was found. It is shown that fixed-u features in pi p

scattering will lead to nonzero values of the asymmetry parameter at fixed-t. (auth)

21316 (ANL/HEP-CP-75-58, pp 137-145) pi⁻p BACKWARD ELASTIC SCATTERING IN THE 5 GeV/c REGION. Dixon, R. L. (Purdue Univ., Lafayette, IN); Fletcher, J. M.; Garfinkel, A. F.; Loeffler, F. J.; Mudrak, S.; Shibata, E. I.; Stanfield, K. C.; Tang, Y. W.; Hoffman, E. W. 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Preliminary results are reported for pi⁻p yields p pi⁻ differential cross sections at six beam momenta between 4.75 and 5.2 GeV/c for 0 greater than u greater than -0.7 $(GeV/c)^2$. These data are discussed in terms of the possible existence of narrow structure in the center-of-mass energy dependence as would be exhibited by an Ericson fluctuation or a narrow pion-nucleon resonance. (auth)

21317 (ANL/HEP-CP-75-58, pp 146-150) ERICSON FLUCTUATION EXPERIMENTS AT ARGONNE. Peterson, E. (Univ. of Minnesota, Minneapolis). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

An experiment to search for Ericson fluctuations in pi⁻ and pi⁺ large-angle elastic scattering at 2 to 9 GeV/c is reported. The results are preliminary, but as yet no indication is found for large variations in the differential cross section for pi p scattering between adjacent 1 percent momentum intervals. (JFP)

21318 (ANL/HEP-CP-75-58, pp 194-208) NEW PARTICLES PRODUCED IN ELECTRON–POSITRON ANNIHILATION. Perl, M. L. (Stanford Linear Accelerator Center, CA). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The main properties of the new particles produced in e^+e^- annihilation are reviewed. Included are properties of the continuum region, the 4.1-GeV enhancement, the psi and psi', radiative decays of the psi and psi', singly charmed particle searches in $e^+ - e^-$ annihilation, and the e/sub mu/ events. (JFP)

21319 (ANL/HEP-CP-75-58, pp 209-224) RESULTS FROM MIT–BNL EXPERIMENTS. Becker, U. (Massachusetts Inst. of Tech., Cambridge). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Experimental research on the production of meson resonances is summarized. (JFP)

21320 (ANL/HEP-CP-75-58, pp 236-247) SEARCH FOR EXOTICS AND CHARM AT THE CERN OMEGA SPECTROMETER. Navach, F. (Univ., Bari, Italy). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Experimental research on traditional and new meson spectroscopy is summarized. (JFP)

21321 (ANL/HEP-CP-75-58, pp 280-288) SEARCH FOR EXOTIC MESONS AT SLAC. Bonamy, P. (Indiana Univ., Bloomington); Baggett, N.; Fieguth, T. 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The theoretical justification and results from recent experimental searches for backward-produced exotic mesons including two experiments carried out by the collaboration at SLAC are reviewed. The first experiment put upper limits of about 1 to 2 mu b for X^{++} yields (2pi, 4pi, 6pi)$^{++}$ and anti pp pi^+pi^+ in the reaction $pi^+ + p$ yields $X^{++} + n$/sub forward/ at 8.4 GeV/c studied with the SLAC 14 inch rapid cycling bubble chamber triggered by a downstream neutron detector. Also the important features of the recently completed second experiment with the SLAC streamer chamber to study the reaction $pi^- + p$ yields $X^{--} + p$/sub forward/ at 14 GeV/c are discussed. (auth)

21322 (ANL/HEP-CP-75-58, pp 289-294) SOME RECENT RESULTS FROM A STUDY OF $pi^+ - p$ INTERACTIONS AT 15 GeV/c. Baltay, C. (Columbia Univ., New York); Cautis, C. V.; Cohen, D.; Kalelkar, M.; Pisello, D.; Smith, W. D.; Yeh, N. 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The recent results on the pi^+p interactions at 15 GeV/c presented include the observation of a new meson resonance near 2340 MeV, observation of a g - pi threshold effect, the A_4, and the upper limit on nondiffractive A_1 production. (JFP)

21323 (ANL/HEP-CP-75-58, pp 330-342) pi N yields pi N AND KN yields KN LOW ENERGY DATA AND PARTIAL WAVE ANALYSES, RECENT RESULTS AND NEW DIRECTIONS. Kelly, R. L. (Univ. of California, Berkeley). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

This review deals with pi N yields pi N and KN yields KN physics below about 3 GeV/c. An attempt is made to convey the state of the art, and to point out what appear to be promising directions for future research. The situation as of about one year ago is summarized in the 1974 Review of Particle Properties and in London conference talks so concentration is placed on more recent developments. A comprehensive survey is given of pi N yields pi N data between the DELTA region and 3 GeV/c. Problems associated with spin-rotation experiments are discussed and current pi N yields pi N partial wave analyses, I equals 1 and I equals 0 KN yields KN analyses are considered respectively. (auth)

21324 (ANL/HEP/PR-75-59) K/sub L/^{0}p INTERACTIONS AT 550 MeV/c. Cho, Y.; Derrick, M.; Miller, R. J.; Smith, R. P.; Engler, A.; Keyes, G.; Kraemer, R. W.; Schlereth, J.; Tanaka, M. (Argonne National Lab., Ill. (USA); Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). 1975. 14p. Dep. NTIS $3.50.

Differential and channel cross sections and hyperon polarizations are presented for the reactions K^0/sub L/p yields K^0/sub S/p, pi^+ LAMBDA^0, and pi^+ SIGMA^0 at an average beam momentum of 550 MeV/c. These data provide constraints on KN and anti KN amplitudes obtained from charged kaon reactions and reject one of the S equals +1, I equals 0 and one of the S equals -1, I equals 1 phase shift solutions. (auth)

21325 (JINR-D1-5969, pp 75-81) INTERACTION OF STRONGLY UNSTABLE PARTICLES. Aref'ev, A. V.; Bayukov, Yu. D.; Efremenko, V. I.; Zaitsev, Yu. M.; Kozodaev, M. S.; Kuleshova, L. N.; Leksin, G. A.; Suchkov, D. A. 1971. (In Russian)

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21326 (JINR-D1-5969, pp 87-101) THREE-AND-FOUR-PION ANGULAR CORRELATIONS IN 8 GeV/c π^+p INTERACTIONS. Coghen, T. (Inst. of Nuclear Physics, Krakow). 1971.

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

Evidence is presented for the existence of very strong correlations of the angular distributions with the charge configuration of the three- and four-pion groups based on eight-prong π^+p interactions at 8 GeV/c. (JFP)

21327 (JINR-D1-5969, pp 102-109) POSSIBLE EXISTENCE OF $\pi^-\gamma$ RESONANCES WITH MASS OF 270 MeV. Budagov, Yu. A.; Vinogradov, V. B.; Volod'ko, A. G. 1971. (In Russian)

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21328 (JINR-D1-5969, pp 110-120) π^+p INTERACTIONS AT 8 GeV/c WITH THE LOWEST ENERGY PER PARTICLE /10-PRONG EVENTS/. Aniola, L. (Inst. of Nuclear Techniques, Krakow); Bartke, J.; Coghen, T. 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The results of a study of pion production in pion–proton interactions at 8 GeV/c with ten charged prongs (relatively rare events) are presented. Total cross sections, single-particle distributions, and angular correlations are discussed. (JFP)

21329 (JINR-D1-5969, pp 121-133) $\pi\pi$ PHASE SHIFTS IN THE REACTION $\pi^+p \to p\pi^+\pi^+\pi^-$ AT 8 GeV/c AND Kπ CHEW–LOW ANALYSIS IN THE REACTION $K^-p \to pK^-\pi^+\pi^-$ AT 10 GeV/c. Aachen-Berlin-CERN-London-Vienna Collaboration. 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

A $\pi\pi$ phase-shift analysis is performed with the fundamental assumption of one-pion-exchange. There are two possible solutions, one of which resonates at approximately 700 MeV leading to a I = 0 s-wave resonance at 710 ± 80 MeV with $\Gamma^0_\rho \pm 140 \pm 20$ MeV. The reaction $K^-p \to K^-p\,\pi^+\pi^-$ was used to measure the $K^-\pi^-$ elastic differential and total elastic cross section by a Chew-Low extrapolation. The elastic cross section has no structure and goes down from about 4 mb at threshold to approximately zero mb at 2.0 GeV. Using the optical theorem an upper limit of the total cross section of $K^-\pi^-$ scattering was also determined. (auth)

21330 (JINR-D1-5969, pp 134-152) INFLUENCE OF RESONANCE PRODUCTION ON THE TRANSVERSE MOMENTUM DISTRIBUTIONS OF SECONDARIES PRODUCED IN A π^-p COLLISIONS AT 16 GeV/c. Aachen-Berlin-Bonn-CERN-Heidelberg Collaboration. 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The square of the transverse momentum of secondaries produced in 16 GeV/c π^-p collisions was investigated. For pions and neutrons the $\alpha\delta/\alpha p_\perp^2$ has both steep and shallow components which can be described at best with a sum of two exponentials. The break occurs at about $p_\perp^2 = 0.15$ (GeV/c)^2. For the proton only some indications of such a behavior are observable. It turns out that the sharp forward peaks are mainly produced by decay products of small Q-value nucleon resonances. The influence of small two-body masses to the sharpening effect is negligible. (auth)

21331 (JINR-D1-5969, pp 153-159) PION–NUCLEON AND COHERENT INTERACTIONS OF MESONS IN PHOTOEMULSIONS AT MOMENTUM OF 50 GeV/c. Baatar, Ts.; Tuvdendorzh, D.; Chadraa, B.; Sharkhuu, G. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21332 (JINR-D1-5969, pp 160-166) LOW-ENERGY PROTONS GENERATED IN INTERACTIONS AT PRIMARY ENERGIES OF 60 AND 1000 GeV. Babetski, Ya.; Furman'ska, V. (Inst. of Nuclear Physics, Krakow). 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21333 (JINR-D1-5969, pp 369-438) EXPERIMENTAL JUSTIFICATION FOR THE DIFFRACTION DISSOCIATION MODEL IN STRONG INTERACTIONS. Nowak, S. (Institut fuer Hochenergiephysik, Berlin). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. Joint Inst. for Nuclear Research, Dubna (USSR)).

A short review on the experimental facts concerning the diffraction dissociation model in strong interactions is given. The eight properties of diffraction dissociation listed previously are discussed. Also energy independent boson mass enhancements and the deck effect, baryon spectra, energy dependence of mass enhancements and D-resonances, coherent production, factorization, t-dependence and double dissociation processes, spin- and parity assignments, and s- and t-channel helicity conservation. (JFP)

21334 (LAL-1284) EVIDENCE FOR $\rho\pi$ DOMINANCE IN $\phi \to 3\pi$ DECAY. Parrour, G.; Cosme, G.; Courau, A. (Ecole Normale Superieure, 91–Orsay (France). Lab. de l'Accelerateur Lineaire). Jan 1976. 13p. Dep. NTIS (US Sales Only) $3.50.

About 700 $\pi^+\pi^-\pi^0$ events produced by e^+e^- annihilation at the ϕ meson energy are analyzed by comparing the experimental Dalitz plot to the distributions predicted by either a Lorentz invariant phase-space production of the three pions or by a dynamical $\phi \to \rho\pi \to \pi^+\pi^-\pi^0$ process as given by the Gellman-Sharp-Wagner model. The result gives clear evidence for $\rho\pi$ dominance. (auth)

21335 REACTION $K^- + p \to \Lambda + \pi^0$ FROM 1647 TO 1715 MeV. Ponte, R.A.; Hertzbach, S.S.; Button-Shafer, J.; Yamamoto, S.S. (University of Massachusetts, Amherst, Massachusetts 01002); Hart, E.L.; Rice, R.M.; Bacastow, R.B.; Fung, S.Y. Phys. Rev. D 12: No. 9, 2597-2609 (1 Nov 1975).

This paper contains the results of a study of the reaction $K^-p \to \Lambda\pi^0$ in the center-of-mass-system-energy region of 1647 to 1715 MeV. An energy-dependent partial-wave analysis was performed in this channel. Two allowable solutions were obtained. The first solution in this region contains the D_{13} [$t = 0.08 \pm 0.01$, $\Gamma\ (E_R) = 44 \pm 11$ MeV, and $E_R = 1671 \pm 3$ MeV] partial wave as the only resonant amplitude; the second solution contains both the P_{11} [$t = 0.16 \pm 0.01$, $\Gamma\ (E_R) = 81 \pm 10$ MeV, and $E_R = 1671 \pm 2$ MeV] and the D_{13} [$t = 0.17 \pm 0.01$, $\Gamma\ (E_R) = 76 \pm 5$ MeV, and $E_R = 1655 \pm 2$ MeV] partial wave as resonant. (auth)

21336 STUDY OF K^+d ELASTIC SCATTERING IN THE REGION OF 600 TO 900 MeV/c. Sakitt, M.; Skelly, J.; Thompson, J.A. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 12: No. 11, 3386-3392 (1 Dec 1975).

Measurements of the differential cross section for the coherent elastic scattering process $K^+d \to K^+d$ are presented at four momenta from 600 MeV/c to 890 MeV/c for $0.03 < |t| < 0.25$ (GeV/c)^2. Comparisons are made with previous work and with predictions from partial-wave analyses. (auth)

21337 ANALYSIS OF THE REACTIONS $\pi^+d \to p_sp\pi^+\pi^+\pi^-\pi^-$ AND $\pi^+d \to p_sp\pi^+\pi^+\pi^-\pi^-\pi^0$ AT 13.1 GeV/c. Badewitz, R.C.; Miller, D.H.; Palfrey, T.R. (Physics Department, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 12: No. 9, 2535-2544 (1 Nov 1975).

We have studied the properties of the reactions $\pi^+d \to p_sp\pi^+\pi^+\pi^-\pi^-$ and $\pi^+d \to p_sp\pi^+\pi^+\pi^-\pi^-\pi^0$ at 13.1 GeV/c with a sensitivity of 9.7 events/μb. We find the cross sections for these reactions to be 490 ± 30 μb and 590 ± 50 μb, respectively. There is significant resonance production in the two reactions but particular final states are difficult to isolate because of the restricted phase space and permutational complexity. The general kinematic features of the reactions are presented and a binary longitudinal-phase-space analysis is applied to the data. Using these techniques the cross sections for the most important contributions to the final states are determined. It is found that significant resonance production occurs in the first reaction but very little in the second reaction with the additional π^0. (auth)

21338 BACKWARD π^-p REACTIONS BETWEEN 0.6 AND 1.0 GeV/c. Debenham, N.C.; Binnie, D.M.; Camilleri, L.; Carr, J.; Duane, A.; Garbutt, D.A.; Jones, W.G.; Keyne, J.; Siotis, I. (Department of Physics, Imperial College, London, England); McEwen, J.G. Phys. Rev. D 12: No. 9, 2545-2556 (1 Nov 1975).

Measurements are reported of the differential cross section for the reaction $\pi^-p \to \pi^-p$, π^0n, and ηn at three angles close to 180° and for incident momenta in the range 0.6 to 1.0 GeV/c. The three measurements were made simultaneously at 1% intervals of beam momentum. The data on elastic scattering resolve a discrepancy between two earlier experiments. They also show clearly the effect of the opening of the ηn channel. The charge-exchange data show that I-spin bounds are not violated in the kinematic region covered. The ηn data can be adequately described with known s-channel resonances. No evidence for narrow N^*'s is seen in any channel. (auth)

21339 INCLUSIVE π^0 PRODUCTION IN π^-p INTERACTIONS AT 5 GeV/c. Burleson, G.; Hicks, G.; Wilson, C.L. (Northwestern University, Evanston, Illinois 60201); Droege, T.; Koehler, P.F.M.; Novey, T.B.; Sandler, B.; Spinka, H.M.; Yokosawa, A.; Ferbel, T. Phys. Rev. D 12: No. 9, 2557-2560 (1 Nov 1975).

We have measured the cross section for the reaction $\pi^-p \to \pi^0 +$ anything at an incident momentum of 5 GeV/c. The two γ rays from π^0 decays were detected using a 150-element lead-glass hodoscope array. A comparison is given of the inclusive π^0 spectrum from hydrogen (obtained through a subtraction of CH_2 and C target data) with π^0 production from C and Cu. (auth)

21340 PRODUCTION OF THE Δ (1950) BY ONE-PION EXCHANGE IN π^+p INTERACTIONS AT 13 GeV/c. Gaidos, J.A.; Miller, D.H. (Physics Department, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 12: No. 9, 2565-2569 (1 Nov 1975).

We have observed the production of high-mass $I = 3/2$ baryon resonances in π^+p interactions at 13 GeV/c. The most prominent of these is found to be the F_{37} Δ (1950). It is produced by one-pion exchange and the data are well described by on-shell π^+p phase shifts. Decays into $p\pi^+$ and $p\pi^+\pi^0$ are observed and the Δ (1950) is found to have a mass 1.880 ± 0.010 GeV and width of 0.180 ± 0.030 GeV with a production cross section of 43 ± 4 μb. (auth)

21341 PRELIMINARY STUDY OF THE $\pi^+\pi^-\pi^+\pi^-$ DECAY MODE OF THE X^0 MESON. Upadhyay, P. N. (Gaya Coll., India). Indian J. Phys.; 49: No. 5, 410-411(May 1975).

The missing mass of the X^0 meson was determined by measuring the neutron time-of-flight and incident pion momentum. The number of these events normalized by 10^8 pion was plotted against the incident pion momentum over the same momentum transfer squared range. This curve for $X^0 \to 2\pi^+\,2\pi^-$, called the yield curve, is plotted. The absence of the enhancement in the yield curve of this decay mode of the X^0 could be attributed to its low branching ratio in this decay mode. (JFP)

21342 STRANGE PARTICLE FINAL STATES FROM 15 GeV/c pi+d INTERACTIONS. Wilkins, D. P. Tallahassee, FL; Florida State Univ. (1975). 146p. University Microfilms Order No. 75-26,832.
Thesis (Ph. D.).
Strange particle final states from a pi+d experiment at 15 Gev/c are analyzed. Results include evidence for a new resonance in the k/sub s/K/sub s/ system, a possible new resonance in the K/sub s/ pi+pi- system with the decay mode K*(890)pi, cross sections for inclusive production of K/sub s/K/sub s/, K^0LAMBDA^0, LAMBDA^0 anti LAMBDA^0, and a charm search that may suggest the existence of a charmed baryon with positive charge and mass approximately 2.8 GeV/c^2. (Diss. Abstr. Int., B)

21343 MEASUREMENTS OF e^+e^- yields e^+e^-, e^+e^- yields mu^+mu^- AND e^+e^- yields gamma gamma AT CENTER OF MASS ENERGIES CLOSE TO 3105 MeV. Hofstader, R. (Stanford Univ., CA); Ford, R. L.; Beron, B. L. pp 21-28 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).
From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.
From an initial study of the PSI(3105) resonance that this particle, if its spin–parity assignment is 1^-, decays with approximately equal probability into electron–positron and muon pairs and that to within the precision of the present data the rate of the reaction e^+e^- yields 2 gamma at center of mass energies close to 3105 MeV is consistent with that expected from quantum electrodynamics. (JFP)

21344 CORRELATION OF MOMENTUM CHARACTERISTICS OF PARTICLES FROM INELASTIC PION–PROTON INTERACTIONS. Gaitinov, A. Sh.; Izbasarov, M.; Takibaev, Zh. S.; Chasnikov, I. Ya. (Inst. of High Energy Physics, Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 222: No. 5, 1068-1070(11 Jun 1975). (In Russian).
The correlation of momentum characteristics is investigated as a function of the number of particles in the final state and the coefficient of inelasticity for four-ray and six-ray, pion-proton interactions. A total of 3000 events on the 81 cm and two-meter hydrogen bubble chambers at CERN are analyzed. (SJR)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 21281.

21345 (TID-26946) STUDY OF THE REACTION K-n yields pi-pi-SIGMA+ USING A NEWLY DEVELOPED ISOBAR MODEL WITH UNITARITY. Capps, C. D. (Florida State Univ., Tallahassee (USA)). 1975. 86p. Dep. NTIS $5.00.
Thesis.
An isobar model utilizing some (all of the T matrix unitarity equations containing 3 yields 3 amplitudes are ignored) of the constraints imposed by unitarity is developed. This model is then used to analyze the reaction K-n yields pi-pi-SIGMA+ in the energy region 1.62 to 1.73 GeV. Branching fractions for the decay of formation channel resonances into the excited baryon states LAMBDA (1405)pi, LAMBDA(1520), and SIGMA(1385)pi are obtained. (auth)

General

Refer also to abstracts 21282, 21532, and 21533.

21346 (ANL/HEP-CP-75-58) NEW DIRECTIONS IN HADRON SPECTROSCOPY. Proceedings of the Summer Symposium Held at Argonne, Illinois, July 7–10, 1975. Kramer, S. L.; Berger, E. L. (eds.). (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 417p. (CONF-750729-). Dep. NTIS $11.00.
Separate abstracts were prepared for the 36 papers presented. (JFP)

For abstracts of individual papers see: 21288–21294, 21310–21323, 21347, 21366, 21424, 21425, 21451–21456, 21479–21481, 21498, and 21499.

21347 (ANL/HEP-CP- 75-58, pp 96-114) SPECTROSCOPY AFTER THE NEW PARTICLES. Lipkin, H. J. Weizmann Inst. of Science, Rehovoth, Israel). 1975.
From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).
In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Conventional spectroscopy is reexamined in a search for puzzles and paradoxes which have arisen in attempting to describe the properties of the known particles. These may offer clues to the missing elements necessary for the description of the new particles. The minimum number of elementary building blocks, charm and color, the colored quark model for saturation, spin splittings in the meson spectrum, three kinds of quarks, the Melosh transformation and the Jackson frame, beyond the single-quark transition—the Zweig rule mystery, new particles and old symmetries, the f–A2 interference, and tests of the Zweig rule by rho–omega and f–A2–f' interference are considered. (JFP)

21348 (ANL/HEP/PR-76-03) INTERCEPTS AND RESIDUES OF REGGE POLES IN A STOCHASTIC-FIELD MULTIPARTICLE THEORY. Arnold, R. C. (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. 16p. Dep. NTIS $3.50.
A dynamical theory of multiparticle amplitudes, based on a functional integral representation embodying collective long-range correlations, is applied to the calculation of Regge intercepts and residues. Poles arising in conventional multiperipheral models will characteristically be modified in three ways: promotion, renormalization, and a proliferation of dynamical secondary trajectories, reminiscent of dual models. (auth)

21349 (JINR-D1-5969) PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON HIGH ENERGY PHYSICS, DRESDEN, GERMANY, APRIL 19–27, 1971. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1971. 778p. (In Russian and English). (CONF-710437-).
The conference included 40 papers. Separate abstracts were prepared. (JFP)

For abstracts of individual papers see: 20321–20323, 20959, 21279, 21280, 21283, 21286, 21298–21301, 21325–21333, 21350–21354, 21368, 21402, 21403, 21426, 21458–21460, 21482, 21483, 21500, 21519, 21526, 21527, and 21885.

21350 (JINR-D1-5969, pp 463-487) INCLUSIVE MANY-BODY REACTIONS. Feynman Scaling and the Multiperipheral Model. Ranft, G. (Karl-Marx-Univ., Leipzig). 1971.
From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).
In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).
The formulation of inclusive single particle spectra with the use of the multi-Regge model is reviewed with special emphasis on very recent work. Different sets of variables used for single particle spectra are collected. Attention is drawn to the just starting multi-Regge phenomenology of inclusive particle spectra. The scaling and pionization behavior of the various multi-Regge graphs are discussed. (auth)

21351 (JINR-D1-5969, pp 488-509) SINGLE PARTICLE DISTRIBUTIONS AND DUAL MODELS. Biebl, K. J. (Institut fuer Hochenergiephysik, Berlin). 1971.
From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).
In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).
Starting from a formula which represents the single particle distribution as an expectation value of the particle number density operator, the energy-momentum sum rules, the optical theorem and the Regge behavior of single particle distributions are treated. The predictions for the single particle distribution obtained from planar 6-point Veneziano functions by means of the optical theorem are considered in detail, in particular the scaling behavior, the exponential decrease at large transverse momenta in the pionization region and the fragmentation regions, and the mass dependence of the distribution functions and of the mean transverse momentum. Contributions of Pomeron exchange with background behavior in the dual channels are discussed. (auth)

21352 (JINR-D1-5969, pp 558-563) INVESTIGATION OF SCATTERING AMPLITUDES OF HIGH ENERGY PARTICLES ON THE BASIS OF THE BETHE–SALPETER EQUATION. Smondyrev, M. A. 1971. (In Russian)
From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).
In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21353 (JINR-D1-5969, pp 632-648) CURRENTS IN THE DUAL RESONANCE MODEL. Csikor, F. (Roland Eotvos Univ., Budapest). 1971.
From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

What are believed to be the best attempts to construct dual current amplitudes are summarized. It is found possible to construct realistic models to the extent that the connected on-shell amplitudes are known. Factorization is required only on the leading trajectory with the result that the amplitudes are non-unique. (JFP)

21354 (JINR-D1-5969, pp 703-773) APPLICATIONS OF THE GENERALIZED VENEZIANO MODEL. Schreiber, M. J. (Institut fuer Hochenergiephysik, Berlin). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The generalized Veneziano model, in particular the 5-point function and its applications to experimental data are reviewed. The main features of the B5-amplitude and the question what futher approximations are needed to describe experimental results are outlined. In general, for reactions involving only two baryons the model is able to reproduce main features of the data. Violent disagreement is observed for processes involving four baryons. The questions of the correctness of "duality diagrams" and Pomeron-inclusion are discussed. Outstanding problems are summarized. (auth)

21355 REGGE TRAJECTORIES IN THE AMATI–BERTOCCHI–FUBINI–STANGHELLENI–TONIN MULTIPERIPHERAL MODEL. Saxton, O. H. N. Princeton, NJ; Princeton Univ. (1974). 158p. University Microfilms Order No. 75-20,658.

Thesis (Ph. D.).

The Regge trajectory structure is investigated analytically in the simple ABFST model for the absorptive part of the scattering amplitude of two scalar particles. The integral transforms of Abarbanel and Saunders which are needed to diagonalize the integral equation in the forward and in the nonforward cases are presented. The connection between the two transformed amplitudes is established, and this shows the existence of Toller families of trajectories. A discussion is given of how a pole in the transform variable in either of these amplitudes lead to Regge behavior of the full amplitude. (Diss. Abstr. Int., B)

21356 SUM RULES AND TRANSVERSE-MOMENTUM FLUCTUATIONS IN SEMI-INCLUSIVE REACTIONS. Hayot, F. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. D 12: No. 9, 2751-2755 (1 Nov 1975).

We derive sum rules and set up a formalism for transverse-momentum fluctuations in semi-inclusive reactions. We discuss the relevance of these fluctuations for the determination of the transverse-momentum structure of multiparticle events. (auth)

21357 UNIFIED INTERACTIONS OF LEPTONS AND HADRONS. Fritzsch, H.; Minkowski, P. (California Institute of Technology, Pasadena, California 91125). Ann. Phys. (N.Y.) 93: No. 1, 193-266 (5 Sept 1975).

It is suggested that a unifying description of leptons and hadrons can be obtained within a nonabelian gauge theory where the gauge group is a symmetry group of a set of massless elementary fermions (leptons, quarks). We investigate the consequences of such an approach for the strong, electromagnetic, and weak interactions. We study both gauge theories with and without fermion number conservation, e.g., theories based on the groups $SU_n \times SU_n (n=8, 12, 16)$ and $SO_n (n=10, 14)$. (auth)

21358 IS ψ' (3700) A RADIAL EXCITATION OF ψ (3100)? Kang, J.S.; Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 12: No. 9, 2791-2797 (1 Nov 1975).

The proposal that ψ' (3700) and ψ'' (4200) are radial excitations of the ψ (3100) charmed-quark-antiquark bound state is reexamined within the context of linear-potential models. If the interaction energy per unit length is universal, this assignment of ψ' and ψ'' *must* be retained. If this potential differs for each system, then one may abandon this assignment of ψ' and ψ'' at the expense of making the ψ system relativistic and the charmed-quark mass light. A harmonic-oscillator model is also considered, with substantially the same conclusions. (auth)

21359 MELOSH TRANSFORMATION: THEORY AND EXPERIMENT. Hey, A. J. G. (Southampton Univ., Eng.). Acta Phys. Pol., Ser. B6: No. 6, 831-849(1975).

The theoretical and experimental developments in the search for a transformation between current and constituent quarks are surveyed. (auth)

21360 MELOSH TRANSFORMATION FOR INTERACTING QUARKS. Ruegg, H. (Univ., Geneva). Acta Phys. Pol., Ser. B6: No. 6, 851-864(1975).

Recent developments in the problem of the Melosh transformation for interacting quarks are discussed. (auth)

21361 CORRELATIONS IN MULTIPARTICLE PRODUCTION. Ranft, J. (Karl-Marx Univ., Leipzig). Fortschr. Phys.; 23: No. 8, 467-531(1975).

The discussion of correlations in multiparticle production includes definitions related to correlations, experimental data on correlations, further methods of correlation analysis, and correlation studies in models for multiparticle production. (JFP)

21362 DEUTERON AS TARGET IN HIGH ENERGY REACTIONS. Fridman, A. (Centre de Recherches Nucleaires, Strasbourg). Fortschr. Phys.; 23: No. 5, 243-315(1975).

The use of the deuteron in high energy reactions is studied. The studied reactions are induced by beam particles having a momentum of the order of or greater than a few GeV/c. A brief survey is given of deuteron properties; then the physical information which can be extracted from reactions using a deuterium target is studied. (JFP)

21363 MONOPOLE STRINGS AND CHARMONIUM. Balachandran, A. P. (Syracuse Univ., New York); Ramachandran, R.; Schecter, J.; Wali, K. C.; Rupertsberger, H. pp 341-347 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

We show that the strength of the potential which varies as the distance between quarks can be related to the universal Regge slope parameter alpha'. This relation is in excellent agreement with the phenomenological analysis of the newly discovered resonances psi(3.1) and psi(3.7) by Eichten et al.

21364 FIXED PAST AND UNCERTAIN FUTURE: A SINGLE-TIME COVARIANT QUANTUM PARTICLE MECHANICS. Noyes, H. P. (Stanford Univ., CA). Found. Phys.; 5: No. 1, 37-43(Mar 1975).

A covariant quantum mechanics for systems of finite-mass particles at finite energy follows from interpreting as Wick–Yukawa fluctuations in particle number the quantum fluctuations which are needed by Phipps to understand measurement theory and by Gyftopoulos to understand the second law of thermodynamics. The dynamical one-variable equations require as input the (N–1)-particle transition matrices and an N–N vertex or coupling constants at three-particle vertices. (auth)

21365 SCALING BEHAVIOR OF SECOND-ORDER PHASE TRANSITIONS. van Royen, R. P. (Univ., Nijmegen, Netherlands). Lett. Nuovo Cim.; 15: No. 3, 70-74(17 Jan 1976).

Starting from the Landau Hamiltonian, using a summation procedure with some other assumptions, one presents a proof of scaling for any continuous dimension below four. (JFP)

Electromagnetic

Refer also to abstracts 20990, 21523, 21890, 21908, 21935, 21942, and 21943.

21366 (ANL/HEP-CP-75-58, pp 225-235) HEAVY QUARKS AND THEIR EXPERIMENTAL CONSEQUENCES. Applequist, T. (Fermi National Accelerator Lab., Batavia, IL). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Recent theoretical work on heavy quark dynamics is reviewed. In the context of a color gauge theory of strong interactions, the structure of heavy quark-antiquark bound states and their decay properties is discussed. The emphasis is on the dynamical differences between heavy and light quark bound states. It is suggested that the former will more directly reflect the structure of the underlying field theory. (auth)

21367 (IS-T-706) ELECTROMAGNETIC FORM FACTORS OF HADRONS. Zidell, V. S. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 225p. Dep. NTIS $7.75.

Thesis.

A vector meson dominance model of the electromagnetic form factors of hadrons is developed which is based on the use of unstable particle propagators. Least-square fits are made to the proton, neutron, pion and kaon form factor data in both the space and time-like regions. A good fit to the low-energy nucleon form factor data is obtained using only rho, omega, and phi dominance, and leads to a determination of the vector meson resonance parameters in good agreement with experiment. The nucleon-vector meson coupling constants obey simple sum rules indicating that

there exists no hard core contributions to the form factors within theoretical uncertainties. The prediction for the electromagnetic radii of the proton is in reasonable agreement with recent experiments. The pion and kaon charge form factors as deduced from the nucleon form factors assuming vector meson universality are compared to the data. The pion form factor agrees with the data in both the space and time-like regions. The pion charge radius is in agreement with the recent Dubna result, but the isovector P-wave pion-pion phase shift calculated from the theory disagrees with experiment. A possible contribution to the form factors from a heavy rho meson is also evaluated. (auth)

21368 (JINR-D1-5969, pp 167-200) ELECTROMAGNETIC INTERACTIONS OF HIGH-ENERGY PARTICLES. Lapidus, L. I. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21369 (ORO-243) RADIATIVE DECAY OF THE J(psi) AND OTHER VECTOR MESONS IN SU(4). Bohm, A.; Hossain, M.; Kagali, B. A.; Moylan, P.; Teese, R. B.; Valanju, P. M. (Texas Univ., Austin (USA). Center for Particle Theory). Dec 1975. Contract AT(40-1)-3992. 8p. Dep. NTIS $3.50.

The known radiative decay rates of the "old" vector mesons are used to determine the suppression factor for the spectrum generating SU(4) group. From the suppression factor the decay rate for J(psi) yields chi(2.75) + gamma and for the radiative decays of other vector mesons. (auth)

21370 (ORO-244) NEUTRINO PAIR BREMSSTRAHLUNG INCLUDING NEUTRAL CURRENT EFFECTS. Dicus, D. A.; Kolb, E. W.; Schramm, D. N.; Tubbs, D. L. (Texas Univ., Austin (USA). Center for Particle Theory). Jan 1976. Contract AT (40-1)-3992. 22p. Dep. NTIS $4.00.

In regions of extreme degeneracy the only process for neutrino pair production which is not suppressed is neutrino bremsstrahlung by a degenerate electron gas interacting with the nuclear Coulomb fields. This process is calculated in a general weak interaction model which includes neutral currents. A static Coulomb potential is assumed and both weak and strong screening are considered. In the limit of extreme degeneracy an analytic approximation for the energy loss rate is given. It is found that neutral currents change the energy loss rate only slightly; for example, in the Weinberg-Salam model the rate is about 1.3 times the rate in the V-A theory. The type of screening does not change the rate by more than a factor of two. (auth)

21371 (PP-448) MAGNETIC MONOPOLES AND TACHYONS IN SPECIAL RELATIVITY. Recami, E.; Mignani, R. (Catania Univ. (Italy). Istituto di Fisica Teorica). Dec 1975. 9p. Dep. NTIS (US Sales Only) $3.50.

The mere special relativity does not explicitly predict existence of (sub-luminal) monopoles, but on the contrary explicitly predicts existence of Super-luminal (tachyon) monopoles, with magnetic charge about 100 times less than usually assumed. This fact is relevant also at the light of current experiments looking for magnetic poles. (auth)

21372 (PP-449) COMPLEX ELECTROMAGNETIC FOUR-POTENTIAL AND THE CABIBBO–FERRARI RELATION FOR MAGNETIC MONOPOLES. Mignani, R.; Recami, E. (Catania Univ. (Italy). Istituto di Fisica Teorica). Dec 1975. 11p. Dep. NTIS (US Sales Only) $3.50.

Within "extended relativity" one generalizes the Maxwell equations in terms of four-potentials for both ordinary and faster-than-light charges. One succeeds in giving a physical meaning to the complex electromagnetic four potential (and to complex electromagnetic four-current tensor and field), and a new interpretation to the Cabibbo–Ferrari relation for magnetic monopoles. (auth)

21373 ANALYSIS OF PROTON–PROTON INTERACTIONS AS LOW ENERGIES. Naisse, J. P. (Libre Univ., Brussels). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 6, 589-609(1975). (In French)

The introduction of relativistic corrections to electromagnetic effects in the treatment of proton–proton inelastic scattering at low energies is affected by a certain number of fundamental ambiguities. The significance of the latter is examined at the level of very high precision data collected in the low energy range. (tr-auth)

21374 ANGULAR DISTRIBUTION OF PARTICLES FROM TRANSVERSELY POLARIZED e^+e^- COLLIDING BEAMS. Tsai, Y.S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 12: No. 11, 3533-3538 (1 Dec 1975).

The effects of transversely polarized electron and positron beams in e^+e^- colliding-beam experiments are discussed. (auth)

21375 RESONANCES DECAYING TO A PHOTON AND A J (ψ) PARTICLE. Babcock, J.; Rosner, J.L. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. D 12: No. 9, 2761-2764 (1 Nov 1975).

If $L = 1$ orbital excitations $^3P_{2,1,0}$ of the J (ψ) particle exist (assuming it to be a $^3S_1$ quark-antiquark state), the decays $^3P_{2,1} \to J$ (ψ) $+ \gamma$, J (ψ) $\to$ (lepton)$^+$ + (lepton)$^-$ are predicted to yield $W(^3P_2,\theta) \propto 1 +$ (0.4 to 0.6) $\cos^2\theta$ and $W(^3P_1\theta) \propto \sin^2\theta$. Here $W(\theta)$ is the distribution in angle θ between the photon and either lepton in the J (ψ) rest frame. The decay $^3P_0 \to J$ (ψ) $+ \gamma$ [which must have W $(^3P_0,\theta) \sim 1 + \cos^2\theta$] is predicted to be suppressed. (auth)

21376 DEEP-INELASTIC ELECTROPRODUCTION OF PIONS IN A QUARK-PARTON MODEL. Vislay, M.E.; Carlson, C.E. (Physics Department, College of William and Mary, Williamsburg, Virginia 23185). Phys. Rev. D 12: No. 9, 2670-2676 (1 Nov 1975).

Invariant cross sections for the processes $ep \to e\pi^+ +$ anything are calculated in a quark-parton model. We use a wave-function formalism which we show to be equivalent to the Kuti-Weisskopf quark-parton model of hadrons. Imposing simplifying assumptions valid for a high-momentum final state, we obtain good agreement with existing experimental data. (auth)

21377 FRACTION OF K^- IN THE e^+e^- ANNIHILATION AT 4.15 GeV–THE CHARM AND COLOR SCHEME. Machacek, M.; Tomozawa, Y.; Yun, S.K. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 12: No. 9, 2925-2927 (1 Nov 1975).

A model based on the SU(4) $\times$ SU(3) $\cdot$ group is proposed. The 4.15-GeV bump in the e^+e^- reaction is associated with a sum of the closely spaced color excited resonances, in order to explain the recently observed K fraction. (auth)

21378 SEPARATION OF $\psi \to \pi^+\pi^-\gamma$ FROM $\psi \to \pi^+\pi^-\pi^0$. Cahn, R.N. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 and University of Washington, Seattle, Washington 98195). Phys. Rev. D 12: No. 11, 3556-3558 (1 Dec 1975).

Angular distributions provide a means for determining the frequency of the decay $\psi \to \pi^+\pi^-\gamma$ which is generally indistinguishable from $\psi \to \pi^+\pi^-\pi^0$ on the basis of the neutral missing mass alone. Radiative decays such as $\psi \to \pi^+\pi^-\gamma$ might be expected to be significant on the basis of vector dominance or as a consequence of charm or color models for the ψ. (auth)

21379 MESON EXCHANGE CURRENTS IN DEUTERON ELECTRODISINTEGRATION AND THE NUCLEON AXIAL VECTOR FORM FACTOR. Lock, J.A.; Foldy, L.L. (Case Western Reserve University, Cleveland, Ohio 44106). Ann. Phys. (N.Y.) 93: No. 1, 276-334 (5 Sept 1975).

Double differential cross sections for deuteron electrodisintegration near threshold from back-scattered electrons were calculated for electron four-momentum transfer squares in the range $0 \leq \Delta^2 \leq 15$ fm^{-2} and for final n-p relative energies in the range $0 \leq E_{rel} \leq 15$ MeV using the Reid hard-core parametrization of the n–p potential and considering the free nucleon or impulse process and various one-pion exchange processes. Particular attention was paid to the study of the form factors of the mesonic processes and to the dependence of the cross section on various n–p potentials. In particular, the cross section was found to be dominated by the impulse process for $\Delta^2 \leq 8$ fm^{-2} and by the catastrophic meson exchange process for $\Delta^2 \geq 8$ fm^{-2}. Since in dispersion theories, the catastrophic process is proportional to the isovector Dirac nucleon form factor $F_1^{\,v}(\Delta^2)$ while in PCAC-current algebra theories it is proportional to the nucleon axial vector form factor $F_A(\delta^2)$, a determination of the catastrophic form factor was undertaken. It was found that the experimental data was reasonably fitted by $F_A(\Delta^2) = (1+\delta^2/m_A^2)^{-2}$ with m_A=0.81 GeV. This value of m_A is within the range of values determined from neutrino scattering experiments. Further, the cross section was found to be relatively insensitive to the n–p potential employed providing it exhibits repulsive core behavior for $r \lesssim 0.5$ fm. Finally, possible parametrizations of the off-shell contributions to the pion form factor and contributions to the cross section from scattering to the $^3S_1 - {}^3D_1$ and $l>0$ final states were examined. (auth)

21380 TRANSITION RADIATION BY A CHARGED PARTICLE MOVING ACROSS A PLASMA SHEET. Sharma, S.R.; Swami, K.C. (Department of Physics, University of Rajasthan, Jaipur 302004, India). J. Appl. Phys. 47: No. 1, 74-77 (Jan 1976).

Expressions are derived for the transition radiation fields due to a charged particle passing across a dielectric layer surrounded by media of different dielectric constants. Transition radiation for a cold plasma sheet is discussed in detail and radiation patterns on both sides of the sheet are presented for different values of the particle velocity and the thickness of plasma sheet. The radiation patterns are found to depend sensitively on these parameters. (auth)

21381 THE NEW RESONANCES OBSERVED IN THE CASCADE PHOTON DECAYS OF ψ (3695). Takasugi, E.; Oneda, S. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 12: No. 9, 2914-2917 (1 Nov 1975).

The identification of the newly observed resonance in the cascade photon decay of ψ (3695) is studied. The importance of the approximately "ideal" SU(4) structure for the new resonance is pointed out. The masses of the η_c members of various low-lying 16-plets are computed assuming that they satisfy the "ideal" SU(4) structure. The mass and the width of the $\eta_c(2^{++})$ are especially discussed without assuming the exact "ideal" SU(4) structure. The relatively narrow width of the $\eta_c(2^{++})$ is obtained and the mass is predicted to be around 3.3 GeV, which is close to one of the possible mass values of the new resonance. All our results are obtained in a purely algebraic way, based on asymptotic SU(4), chiral SU(4) $\otimes$ SU(4) charge algebra, and the simple mechanism of symmetry breaking. No inter-16-plet SU(4) mixings are considered. (auth)

21382 ELECTROMAGNETIC MASS DIFFERENCES FROM AN EFFECTIVE LAGRANGIAN. Brown, L.M. (Northwestern University, Evanston, Illinois 60201). Phys. Rev. D 12: No. 11, 3778-3781 (1 Dec 1975).

An effective-Lagrangian model that gave finite lowest-order dynamical electromagnetic corrections to the masses of vector mesons is generalized to a chiral O(4) model, which includes A_1 mesons and pions. Aside from a PCAC (partial-conservation-of-axial-vector-current) "tadpole" term the Lagrangian is chiral-O(4) -symmetric, but a term responsible for supplying a part of the A_1 mass is not gauge-symmetric. Both pion and A_1 mass differences contain logarithmically divergent terms, as in chiral current-algebra calculations. The soft-pion part of the pion mass difference is, however, 3.2 MeV, instead of 5.0 MeV as given by current-algebra and other effective-Lagrangian calculations. (auth)

21383 MODEL-INDEPENDENT STUDY OF LIGHT-CONE CURRENT COMMUTATORS. Gautam, S.R.; Dicus, D.A. (Center for Particle Theory, University of Texas, Austin, Texas 78712). Phys. Rev. D 12: No. 10, 3310-3314 (15 Nov 1975).

An attempt is made to extract information on the nature of light-cone current commutators (LCC) in a model-independent manner. Using simple assumptions on the validity of the Deser-Gilbert-Sudarshan (DGS) representation for the structure functions of deep-inelastic scattering and using the Bjorken-Johnson-Low theorem we show that in principle the LCC may be constructed knowing the experimental electron-proton scattering data. On the other hand, the scaling behavior of the structure functions is utilized to study the consistency of a vanishing value for various LCC under mild assumptions on the behavior of the DGS spectral moments. (auth)

21384 BOUNDS ON HADRONIC VACUUM POLARIZATION. Pham, T.N.; Pire, B.; Truong, T.N. (Centre de Physique Théorique de l'Ecole Polytechnique, 17, rue Descartes-75230 Paris Cedex 05-France). Phys. Rev. D 12: No. 11, 3775-3777 (1 Dec 1975).

Using the Lehmann-Symanzik-Zimmermann bound for the vertex function, we obtain an average upper bound for the ratio of hadrons to muons production in e^+e^- collisions. Bounds for the hadronic contribution to the $(g_\mu - 2)$ factor and the photon propagation function are also given. (auth)

21385 ELECTROMAGNETIC MASS SPLITTINGS OF MESONS IN THE CHARMED-QUARK MODEL. Lichtenberg, D.B. (Physics Department, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 12: No. 11, 3760-3761 (1 Dec 1975).

Assuming that the electromagnetic mass splitting of pseudoscalar and vector mesons results from intrinsic quark mass differences plus Coulomb and magnetic interactions, we derive inequalities among the meson masses, including the masses of charmed mesons. (auth)

21386 CONSTRAINT ON THE CROSS SECTION $\sigma(e^+e^- \to \text{HADRONS})$ FROM THE ASYMPTOTIC BEHAVIOR IN THE SPACELIKE REGION OF THE HADRONIC VACUUM POLARIZATION. Grunberg, G. (Centre de Physique Théorique de l'Ecole Polytechnique, 91120 Palaiseau, France). Phys. Rev. D 12: No. 11, 3682-3697 (1 Dec 1975).

A condition that the absorptive part of the hadronic vacuum polarization must satisfy in order to be consistent with the predictions of asymptotically free field theories in the spacelike region is derived. This condition allows for asymptotic oscillations of the absorptive part, but suitable averages must scale. Applications of the same techniques to the phase representation and to narrow-resonance models are presented. (auth)

21387 UPPER BOUND ON CHARMED QUARKS IN NUCLEONS FROM THE CROSS SECTION FOR ψ (3100) PHOTOPRODUCTION. Goldman, T. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 12: No. 11, 3669-3672 (1 Dec 1975).

A Drell-Yan–type calculation of ψ (3100) photoproduction based on the recent data from SPEAR gives a surprisingly large cross section. If the results of the photoproduction experiment at Fermilab are similar to naive vector-meson-dominance expectations, a stringent upper bound on charmed quarks in nucleons is obtained. A consequence for νW_2 at high ω is also noted. (auth)

21388 PHOTOPRODUCTION OF $J(\psi)$ PARTICLES AND RISING PHOTON-NUCLEON CROSS SECTIONS. Young, B.; Lassila, K.E. (Iowa State University, Ames, Iowa 50010). Phys. Rev. D 12: No. 11, 3424-3430 (1 Dec 1975).

The existence of vector mesons with masses above 3 GeV suggests study of their contributions to the Compton sum rule. The Compton sum rule is used to place upper limits on photoproduction cross section for such recently discovered and yet to be found $J^p = 1^-$ particles. We are led to the result that the total proton photoabsorption cross section and forward Compton-scattering cross section will rise in the range of energies available for photon experiments at the Fermilab accelerator. Discussion is given on the implications of such a rising photon-proton cross section for vector-meson dominance (VMD), the quark model, generalized VMD, and the new duality, and for scaling breaking. (auth)

21389 QUARK MODEL OF PION PHOTOPRODUCTION FROM PROTONS BY POLARIZED PHOTONS IN THE RESONANCE REGION. Berger, S.B.; Feld, B.T. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 12: No. 11, 3488-3500 (1 Dec 1975).

Measurements on the photoproduction of pions from protons by polarized photons are compared with predictions of the conventional quark model in the photon energy range 0.8–1.6 GeV. The experimental data, from an MIT-SLAC collaboration, are for the 90° (in the center-of-mass system) production cross section of positive and neutral pions, both along and normal to the direction of polarization of the incident photons. The computations include s-channel excitation of all observed resonances of mass up to 2 GeV, but neglect nonresonant background effects. Resonances are assigned to the 56-plet representations of SU(6) $\times$ O(3), assuming all baryonic states to be appropriate combinations of three quarks, interacting in an harmonic-oscillator potential. Good qualitative agreement is achieved by appropriate choice of the parameter corresponding to the strength of the potential. A greatly improved fit results from the assignment of the $S_{31}(1535)$ level to the spin-3/2 octet of the 70-plet, first excited baryon supermultiplet. However, attempts at mixing between corresponding levels of the spin-1/2 and spin-3/2 states of this supermultiplet fail to improve the fit. We interpret this as indicating appreciable mixing of the levels concerned with corresponding states of higher supermultiplets of SU(6). (auth)

21390 RESONANCE-MODEL DESCRIPTION OF THE DECAY $\psi(3.1) \to \pi^+\pi^-\gamma$. Tsai, W.; DeRaad, L.L. Jr.; Milton, K.A. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 12: No. 9, 2620-2622 (1 Nov 1975).

The model in which the dipion couples chirally to ψ (3.1) and ψ' (3.7) through the ϵ resonance is used to describe the decay ψ (3.1) $\to \pi^+\pi^-\gamma$. The decay rate may be only slightly depressed from that predicted by the local dipion coupling model, although the corresponding spectra are strikingly distinct. A similar description is given for the analogous decay ρ (770) $\to \pi^+\pi^-\gamma$. (auth)

21391 THEORETICAL SPECTRA AND POLARIZATION IN NEUTRAL-WEAK-BOSON PRODUCTION. Gordon, L.B.; Brown, R.W. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 12: No. 9, 2851-2861 (1 Nov 1975).

We discuss the details of the theoretical predictions for the reaction $l + l^s + N \to Z^0 + l^s + N'$, in which the neutral weak vector boson is radiated by the lepton during electromagnetic recoil off of some nucleus. Energy and angular spectra for the boson, prompt lepton, recoiling proton, and decay leptons are considered. This agenda includes beam polarization effects and a study of the Z^0 polarization. Reference to previous charged-boson theoretical results simplifies our presentation considerably. Ancillary calculations for a scalar Z^0 possibility are described as well. (auth)

21392 SUPPRESSION OF ψ PHOTOPRODUCTION. Aviv, R.; Goren, Y.; Horn, D.; Nussinov, S. (Department of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel). Phys. Rev. D 12: No. 9, 2862-2868 (1 Nov 1975).

We estimate the contribution to ψ photoproduction from its conventional hadronic components by using an ϵ-exchange model. The results, which are too small, are compared with the parallel ρ' case. A reduction factor is observed which also plays an important role in other models. We discuss, in particular, its occurrence in a peripheral model which assumes dominance of new states in the ψ fragmentation vertex which interact strongly with conventional hadrons. The strong reduction factor follows from the mismatch between production thresholds and particle masses. Its role is discussed at length and compared with different points of view. (auth)

21393 $^3P_0$ MODEL AND HELICITY STRUCTURE OF PHOTOPRODUCTION COUPLINGS. Petersen, W. (Daresbury Laboratory, Warrington, Lancashire, England). Phys. Rev. D 12: No. 9, 2700-2708 (1 Nov 1975).

Neglecting the $\Delta L_3=2$ term within the possible algebraic structure in a 35 dimensional $SU(6)_W$ representation for the magnetic-dipole operator is shown to result in the $^3P_0$ model for photodecays of nucleon resonances. We then expand the reduced L_3-changing amplitudes into partial waves and impose a simple $SU(6)_W \times O(2)_{L3}$ constraint on the $W=1$ and $W=0$ parts of the 35. This leads to several more relations among helicity amplitudes for these decays. Using vector dominance and the partial-wave parameters from resonance decays into the lowest-mass meson 35-plet, pseudoscalar decays in particular, we get photodecay couplings which are in good agreement with partial-wave analysis. (auth)

21394 PROTON-NEUTRON MASS DIFFERENCE, ELECTROPRODUCTION, AND PHOTOABSORPTION IN AN ANALYTIC MODEL OF THE VIRTUAL COMPTON AMPLITUDE. Deo, B.B.; Mahapatra, B.P. (Department of Physics, Utkal University, Bhubaneswar-751004, Orissa, India). Phys. Rev. D 12: No. 9, 2709-2724 (1 Nov 1975).

An analytic model of the forward (virtual) Compton amplitude is proposed which satisfies ν plane analyticity, s-u crossing symmetry, Regge behavior, and Bjorken scale invariance in appropriate limits. The model is constructed using the method of conformal mapping. Very good fits are obtained to the electroproduction data on νW_2, $2mW_1$, $\nu W_2 - \nu W_2$, $\nu W_2/\nu W_2$, νR_p, and $1 + \nu W_2/\nu W_2$ and to the photoabsorption data on $\sigma_T(\gamma p)$, σT (γn), and $\sigma_T(\gamma p) - \sigma_T(\gamma n)$. The scale-invariance breaking at finite Q^2 as exhibited by the data on νW_2 plotted as a function of Q^2 with ω fixed is also successfully reproduced. The p-n mass difference calculated using the Cottingham formula is finite. In particular, it is shown that a set of parameters exists for which the general condition for no logarithmic divergence even in the presence of Bjorken scaling giving by $\lim_{Q^2\to\infty} Q^2 \Delta t_1(-Q^2,0) = (\alpha m/\pi) \int_0^1 dx[\Delta F_2(x) + 2x\Delta F_1(x)]$ can be realized consistent with theoretical considerations and experimental data. The final result of our calculation of the mass-difference is (-1.96 ± 0.52) MeV which is to be compared with the experimental value of -1.293 MeV. (auth)

21395 ELECTRON-POSITRON ANNIHILATION CROSS SECTION NEAR THE NEW THRESHOLD. Kogut, J. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853); Susskind, L. Phys. Rev. D 12: No. 9, 2821-2843 (1 Nov 1975).

Heavy-quark models of the new narrow resonances are presented. The relative heaviness of the assumed new quarks suggests applying the adiabatic approximation familiar from molecular physics here. This approach provides partial justification for the use of potential models to describe the new resonances. Vacuum polarization plays an important role in determining the shape of the adiabatic potential. Model calculations of the ψ'' (4.1) are presented. Agreement with experiment is good. A coupled-channel formulation of the narrow resonances and the new threshold is presented. The resulting coupled-channel Schrödinger equations can be solved iteratively. The lowest-order approximation reproduces the adiabatic picture and higher-order corrections are calculable. Several coupled-channel models are analyzed numerically and qualitatively. Although detailed numerical results are model-dependent, certain trends occur. We estimate that the radiative decays of the ψ' (3.7) should be less important than is indicated by naive-pure-quark-model calculations. In addition, the ψ' (3.7) is not a simple two-quark state but has considerable charm-anticharm meson content. The leptonic widths of the ψ (3.1) and ψ' (3.7) are computed and good agreement with experiment is found. Corrections to the adiabatic-potential-model approximation to R $(Q^2) = \sigma (e^+e^- \to \text{hadrons}) / \sigma (e^+e^- \to \mu^+\mu^-)$ above threshold are computed. If the coupled-channel model uses the SU(4) charm scheme, then D^0's are expected to outnumber D's by a wide margin above threshold. The potential-model calculations of R (Q^2) which accept the conventional SU(4) scheme are systematically below the data for $E_{c.m.} \gtrsim 4.6$–4.8 GeV. By adding the contribution of a heavy lepton with mass 2.3–2.4 GeV to the four-quark prediction, a curve of R vs $E_{c.m.}$ which is in good agreement with the data over the entire energy range occurs. (auth)

21396 $d\sigma/d\Omega$ FOR $e^+e^- \to hX$ FROM DIRECT QUARK-LEPTON INTERACTIONS. Greenberg, O.W.; Raychaudhuri, A. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 12: No. 9, 2903-2906 (1 Nov 1975).

$d\sigma/d\Omega$ for $e^+e^- \to hX$ is calculated for the most general electron-quark-heavy boson ("s-channel") or positron-quark-heavy boson ("u-channel") interaction together with the electrodynamic contribution using the naive parton model with collinear quark fragmentation to hadrons. No single S, V, T, A, or P exchange gives isotropic $d\sigma/d\Omega$; V and A exchanges give closest to isotropic. Two linear combinations which give isotropic contributions from the direct quark-lepton interaction are given. (auth)

21397 DIFFRACTIVE NEUTRINO- AND PHOTON-HADRON SCATTERING: RISING CROSS SECTIONS. Hayot, F.; Nieh, H.T. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. D 12: No. 9, 2907-2909 (1 Nov 1975).

We speculate on the possible connections between the nonscaling behavior of the e^+e^--annihilation cross section observed at SPEAR and the results of a recent Fermilab neutrino experiment. We also conjecture that the total photoproduction cross section will begin to rise when the photon energy reaches 40 or 50 GeV. (auth)

21398 EFFECTIVE ANGLES OF XTR EMISSION. Yang, C. (Erevan Physical Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 9: No. 6, 522-524(1974). (In Russian)

The effective angles of XTR emission at the threshold and superthreshold frequencies are determined by the angular range proportional to the reverse Lorentz factor of the charge. At lower frequencies the angles of an order of the ratio of plasma frequency to the radiation frequency also contribute to the total radiation intensity. (auth)

21399 QUANTUM-MECHANICAL WAVE EQUATION FOR TWO PARTICLES OF SPIN 0. Tam, K. C. (Kiangsu-Chekiang Coll., Hong Kong). Aust. J. Phys.; 28: No. 5, 495-501(Oct 1975).

A quantum-mechanical wave equation for two particles of spin 0 is presented in Hamiltonian formalism and is then simplified and discussed. Solutions are found for square-well and Coulomb interactions, and energy levels are determined. It is shown that, for the Coulomb interaction, the energy levels to the lowest order agree with those given by the hydrogen atom formula. (auth)

21400 RADIATION, SELF-POLARIZED ELECTRONS MOVING IN A MAGNETIC FIELD. Bagrov, V. G.; Dorofeev, O. F.; Sokolov, A. A.; Ternov, I. M.; Khalilov, V. R. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 221: No. 2, 312-314(11 Mar 1975). (In Russian).

On movement of electrons in a magnetic field the synchrotron radiation causes transitions with a change in orientation of the electron spin. In this case it is important that the probability of the transitions depends on the direction of the spin, as a result of which electron polarization takes place with the spin being orientated primarily opposite the direction of the magnetic field. This effect is called the radiation self-polarization of electrons. The theory of this effect was developed, and the effect was investigated in detail. The effect of radiation self-polarization has become the main method of obtaining relativistic electrons with oriented spin. The decisive factor in establishing a theory for the radiation self-polarization of electrons was the establishing of covariant methods of describing the spin of electrons moving in an external electromagnetic field. This study briefly reviews the dynamics of the change in electron spin, and shows that 99.05% of the electrons have a spin orientated opposite to the direction of the magnetic field. (SJR)

21401 PROPERTIES OF TRANSITION RADIATION. Maresca, N. J. Ithaca, NY; Cornell Univ. (1975). 199p. University Microfilms Order No. 75-27,046.

Thesis (Ph. D.).

Several fundamental electromagnetic problems associated with the transition radiation accompanying the passage of charged particles through perfectly conducting planar surfaces are investigated. For a charge of uniform but arbitrary velocity incident normally on a grounded, infinitely conducting plane, the exact transition fields are obtained, allowing a detailed analysis of both the radiation distribution and associated transition events. The radiation in this case is also computed by both direct integration of the constructed surface current, and the 'pair annihilation' interpretation of the problem. Subsequent investigation of the electromagnetic annihilation of charge allows establishment of the 'annihilation radiation theorem' relating charge self-energy to annihilation energy. The problem of the radiation loss due to a charge passing through a hole in the plane is then formulated and solved by 'interpolating' between the computed nonrelativistic and existing ultra-relativistic solutions. For nonrelativistic motion, the presence of the source charge is found to induce an infinite number of image multipoles contained within a diameter of the hole, whose associated bremsstrahlung gives rise to the transition radiation of the source. Application of the interpolation formula allows construction of a temperature dependent radiation loss expression appropriate to the passage of a relativistic beam pulse through an aperture. A formula is also developed for the radiation loss suffered by a finite length beam passing through the hole, and employed in estimating the transition radiation losses in the 200-MeV proton LINAC at NAL. Finally, the anomalous intensity peaks due to 'edge waves' appearing in the Fresnel-like diffraction patterns of electron micrographs are investigated qualitatively in connection with the transition radiation associated with the electron beam's traversal of the specimen. (Diss. Abstr. Int., B)

Weak

Refer also to abstract 21438.

21402 (JINR-D1-5969, pp 23-30) REAL PART OF THE AMPLITUDE AND SLOPE PARAMETER OF THE DIFFERENTIAL CROSS SECTION FOR ELASTIC PP SCATTERING AT ENERGIES OF 30, 50, AND 70 GeV. Geshkov, I. M.; Zayachki, V. I.; Ikov, N. L.; Markov, P. K.; Trayanov, R. K.; Chernev, Kh. M. (Physics Inst., Sofia). 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21403 (JINR-D1-5969, pp 243-248) MEASUREMENT OF THE RATIO OF THE PROBABILITY OF DECAY $\Gamma(K_L \to 2\gamma)/\Gamma(K_L \to 3\pi^0)$. Barmin, V. V.; Bryulov, V. G.; Veselovskii, G. S. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21404 HEAVY NEUTRAL LEPTON AS A SOURCE OF DIMUONS IN HIGH-ENERGY NEUTRINO SCATTERING. Chang, L.N.; Derman, E.; Ng, J.N. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. D 12: No. 11, 3539-3549 (1 Dec 1975).

We consider here the possibility that the recently observed oppositely charged muon pairs produced in high-energy neutrino scattering at the Fermi National Accelerator Laboratory originated from the production of a neutral heavy lepton which then decayed into the dimuon pair and a neutrino. Using $V - A$ coupling we have calculated the total cross section for such heavy-lepton production as well as various measurable distributions for the dimuon pairs and for the recoil hadronic mass. Currently available data are displayed together with the prediction of this model. (auth)

21405 ABSENCE (OR SUPPRESSION) OF STRANGENESS-CHANGING, NEUTRAL-CURRENT EFFECTS FROM THE SYMMETRIC QUARK MODEL. Nelson, C.A. (Department of Physics, State University of New York at Binghamton, Binghamton, New York 13901). Phys. Rev. D 12: No. 9, 2869-2874 (1 Nov 1975).

We show that the symmetric quark model, with Bose quarks or as a three-triplet model with perfect SU(3)"-color symmetry supplemented by current algebra and pion partial conservation of the axial-vector current, provides an alternative to (or suppression beyond) introduction of a ρ' "charmed" quark for banishing $|\Delta S| = 2$, $\Delta Q = 0$ nonleptonic effects to order Gs. This mechanism is distinguished by the presence of such effects at high energies to order $(Gs)^2$ and/or $(Gs)(G\bar{t})$ in the amplitude. Previous estimates using the free *three-quartet model* for rare decay modes of the K mesons in the Weinberg-Salam model of weak and electromagnetic interactions are consistent with additional suppression from the quark statistics of the $|\Delta S| = 2$, $\Delta Q = 0$ nonleptonic matrix elements to the level of the $|\Delta| = \frac{3}{2}$ weak amplitude in $K^+ \to \pi^+\pi^0$ if the soft-pion contribution to this amplitude is dominant. (auth)

21406 VECTOR-MESON DOMINANCE CALCULATIONS FOR THE $\bar{\nu}$ ANOMALY AND DIMUON PRODUCTION. Barger, V.; Weiler, T. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Phillips, R.J.N. Phys. Rev. D 12: No. 9, 2628-2631 (1 Nov 1975).

We test quantitatively the hypothesis that the Fermilab anomaly in inclusive $\bar{\nu}N \to \mu^+ X$ distributions comes from charm production via intermediate vector (V) and axial-vector (A) charmed mesons. Theoretical predictions from this mechanism are integrated over the experimental ν and $\bar{\nu}$ spectra, including a scaling background calculated from the parton model. This mechanism can approximately account for the high-y $\bar{\nu}N$ data with an effective charm production threshold $W_{th} = 4$ GeV and F^*N total cross sections of order 10 mb. Better agreement is secured with a higher threshold $W_{th} = 6$ GeV and higher charmed meson-nucleon cross sections. Unsuppressed weak current couplings to charmed D^* mesons could enhance the vector-meson-dominance effect. The ν and p distributions of the fast μ^- in the dimuon events are consistent with this F^* vector dominance contribution. (auth)

21407 DIMUON PRODUCTION ASSOCIATED WITH A SCALAR INTERMEDIATE BOSON CARRYING DILEPTONIC QUANTUM NUMBER. Adler, S.L.; Healy, J.B.; Karliner, I.; Lieberman, J.; Ng, Y.J.; Tsao, H. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 12: No. 9, 2639-2643 (1 Nov 1975).

We calculate the production cross section and kinematic distributions for dimuons arising from the production of a heavy scalar intermediate boson carrying dileptonic quantum number. The low hadron recoil energy and low effective recoiling invariant masses found in this process exclude it as a candidate for the dimuon events recently observed in experiments at the Fermi National Accelerator Laboratory. (auth)

21408 NEUTRINO (ANTINEUTRINO) DISINTEGRATION OF THE DEUTERON AND THE STRUCTURE OF THE NEUTRAL WEAK CURRENT. Ali, A. (Departamento de Física, Centro de Investigación y de Estudios Avanzados del Instituto Politecnico Nacional, Apdo. Postal 14-740, México 14, D.F. and Physics Department, Stevens Institute of Technology, Hoboken, New Jersey 07030); Dominguez, C.A. Phys. Rev. D 12: No. 11, 3673-3681 (1 Dec 1975).

We study the neutrino (antineutrino) disintegration of the deuteron with the view of determining the isospin and Lorentz character of the neutral weak current. Neutrino-induced transition rates between the $^3S \to {}^1S$, $^3S \to {}^1P$, and $^3S \to {}^3P$ of the neutron-proton system are derived for the most general form of the neutral weak current, valid up to intermediate neutrino energies (0–500 MeV). Explicit results are presented for the Weinberg-Salam model, the Bég-Zee model, and the case of an isoscalar neutral weak current. It is argued that this process can be, in principle, used to distinguish between the various assignments of the Lorentz and isospin properties of the hadronic neutral weak current. (auth)

21409 APPLICATION OF CURRENT ALGEBRA TO SOFT-PION PRODUCTION INDUCED BY THE WEAK NEUTRAL CURRENT: SECOND-CLASS V, A CASE. Adler, S.L.; Dashen, R.F.; Healy, J.B.; Karliner, I.; Lieberman, J.; Ng, Y.J.; Tsao, H. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 12: No. 11, 3522-3532 (1 Dec 1975).

We apply current-algebra techniques to study neutrino-proton elastic scattering and neutral-current–induced soft-pion production in the case of second-class vector and axial-vector currents. (Such currents are CP-violating if the final and incident neutrinos are identical, but can be CP-conserving if the final and incident neutrinos are different particles.) The second-class currents are constructed phenomenologically from meson fields and the usual first-class V, A quark currents. The matrix elements of the second-class currents between one-nucleon states are estimated by inserting a complete set of intermediate states and saturating the sum with one-nucleon states. In this way the second-class matrix elements are expressed in terms of the experimentally measured renormalization constant of the first-class V, A currents and the pion-nucleon coupling constants. Using standard soft-pion techniques, we analyze recently reported Brookhaven National Laboratory results for neutral-current–induced soft-pion production under the simplifying assumption of a purely isoscalar second-class V, A neutral current. We find in this case that a second-class $V - A$ current is consistent with the reported results. Some qualitative features of second-class neutral currents are (i) equal cross sections for νp and $\bar{\nu}p$ elastic scattering, with only the axial-vector current contributing, and (ii) very small νp and $\bar{\nu}p$ elastic cross sections at energies of order 50 MeV, which are relevant for possible neutrino experiments of the Los Alamos Meson Physics Facility. (auth)

21410 SCATTERING OF POLARIZED ELECTRONS IN THE QUARK MODEL AND IN THE QUARK-DIQUARK MODEL. Ono, S. (III. Physikalisches Institut, Technische Hochschule Aachen, Aachen, West Germany). Phys. Rev. D 12: No. 11, 3698-3707 (1 Dec 1975).

The inelastic scattering of polarized electrons from polarized nucleons in the resonance region is studied in the quark model and in the quark-diquark model. It is suggested that by the measurement of the polarized cross section in the resonance region information about masses of the constituent particles (quark or quark and diquark) will be obtained. (auth)

21411 QUARK MODEL FOR K_{l3} FORM FACTORS. Isgur, N. (Department of Physics, University of Toronto, Toronto, Ontario, Canada). Phys. Rev. D 12: No. 11, 3666-3668 (1 Dec 1975).

A nonrelativistic quark model for the K_{l3} form factors is presented which provides in a straightforward manner an explanation of their observed characteristics in terms of quark masses. (auth)

21412 APPLICATION OF CURRENT-ALGEBRA TECHNIQUES TO SOFT-PION PRODUCTION BY THE WEAK NEUTRAL CURRENT: S, P, T CASE. Adler, S.L.; Colglazier, E.W. Jr.; Healy, J.B.; Karliner, I.; Lieberman, J.; Ng, Y.J.; Tsao, H. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 12: No. 11, 3501-3521 (1 Dec 1975).

We develop the cross-section formulas needed to correlate information on neutral currents obtained from deep-inelastic neutrino scattering, neutrino-proton elastic scattering, and neutral-current–induced soft-pion production, in the case of neutral currents with S, P, T spatial structure. (The necessary S, P, T current renormalization constants were estimated by us in a previous paper.) The pion-emission amplitude is obtained by current-algebra soft-pion techniques, with the effects of (3, 3) - resonance-excitation taken into account to leading nonvanishing order in

the static approximation. We analyze recently reported Brookhaven National Laboratory results for neutral-current–induced soft-pion production under the simplifying assumption of a purely isoscalar S, P, T neutral current, while simultaneously imposing existing bounds on neutrino-proton elastic scattering and fitting existing data on neutral-current–induced deep-inelastic scattering. If all S, P, T renormalization constants are given their central quark-model values, the elastic-scattering and deep-inelastic restrictions constrain the pion-production cross section to be too low compared with experiment; if apparently reasonable deviations of the parameters from the quark-model values are permitted, satisfactory fits to all data are obtained with S, T, with P, T or with S, P, T mixtures. An isovector tensor or pseudoscalar neutral current is found to lead to a strong (3, 3) peak in πN invariant-mass plots, but an isovector scalar neutral current can be present without producing a visible (3, 3) peak, even when ratios of the various πN charge states produced by the neutral current are appreciably changed from the values which they have in the isoscalar-current case. Two other interesting qualitative features of CP-conserving S, P, T structures are the following: (1) constructive T interference with S (or S and P) in $\nu + N \to \nu + N + \pi$ can accompany destructive interference in $\nu + p \to \nu + p$, and vice versa, and (ii) observation of unequal neutrino- and antineutrino-induced neutral-current cross sections would not be accompanied by neutral-current–induced parity-violating effects in the pp, ep, and μp interactions. (auth)

21413 WEAK MAGNETISM AND PSEUDOTENSOR FORM FACTORS IN $\Sigma^- \to ne\nu$. García, A. (Departamento de Física. Centro de Investigación y Estudios, Avanzados del Instituto Politecnico Nacional, México 14, D. F.). Phys. Rev. D 12: No. 9, 2692-2699 (1 Nov 1975).

It is shown that a precision measurement of the electron-spin asymmetry coefficient in $\Sigma^- \to ne\nu$ can provide an excellent test of the conserved-vector-current hypothesis and of the presence of a large induced pseudotensor form factor. (auth)

21414 CP VIOLATION IN CHARMED-PARTICLE DECAYS. Pais, A.; Treiman, S.B. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 12: No. 9, 2744-2750 (1 Nov 1975).

The discovery of hadrons bearing new quantum numbers ("charm," collectively) would open up new possibilities to pursue the issue of CP violation. The matter of CP signatures for charm-changing processes is discussed in general, model-independent terms save for the assumption that $\Delta C/\Delta Q = 1$ in semileptonic channels. We note certain qualitative differences in the analysis, as compared to charm-conserving reactions. We then raise the issue of indirect effects of CP violation in charm-changing interactions on the neutral K-meson system. In particular an example is discussed in which CP symmetry breakdown is located in the charm-changing interactions and in which the present CP evidence for charm-conserving decays is qualitatively accommodated. The operational distinctions between this mechanism and another interesting possibility, the presence of a "second" superweak interaction (one with $|\Delta C| = 2$), turn out to be delicately linked to CP tests for exclusive decay processes. (auth)

21415 WEAK-INTERACTION MODELS WITH NEW QUARKS AND RIGHT-HANDED CURRENTS. Wilczek, F.A.; Zee, A. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 and Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540); Kingsley, R.L.; Treiman, S.B. Phys. Rev. D 12: No. 9, 2768-2780 (1 Nov 1975).

We discuss various weak-interaction issues for a general class of models within the SU(2) $\times$ U(1) gauge-theory framework, with special emphasis on the effects of right-handed charged currents and of quarks bearing new quantum numbers. In particular we consider the restrictions on model building which are imposed by the small K_L-K_S mass difference and by the $\Delta I = 1/2$ rule, and we classify various possibilities for neutral current interactions and, in the case of heavy mesons with new quantum numbers, various possibilities for mixing effects analogous to K_L-K_S mixing. (auth)

21416 NONLEPTONIC WEAK DECAY AND THE MELOSH TRANSFORMATION. Machacek, M.; Tomozawa, Y. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 12: No. 11, 3711-3729 (1 Dec 1975).

The PCAC (partially conserved axial-vector current) hypothesis and the Melosh transformation are used with the soft-pion and infinite-momentum techniques to obtain expressions for the nonleptonic weak decay of amplitudes of the SU(6)$_W$ 56, $L = 0$ baryons. The following results are obtained: (1) Modified Lee-Sugawara relations are exact for both the parity-violating and parity-conserving amplitudes. (2) Two additional sum rules involving Ω^- decay amplitudes are derived. (3) If the parity-violating part of the weak decay Hamiltonian transforms only as an SU(6)$_W$ 35, then $A(\Sigma^+{}_+) = 0$ automatically. (4) Terms arising from the Melosh transformation are necessary to bring the decay width for $\Omega^- \to \Xi\pi$ into agreement with experiment. (5) All known amplitudes are fitted to within 10%. (auth)

21417 DEEP-INELASTIC NEUTRINO SCATTERING: A DOUBLE SPECTRAL FORM VIEWPOINT. DeRaad, L.L. Jr.; Milton, K.A.; Tsai, W. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 12: No. 11, 3747-3757 (1 Dec 1975).

The scattering of neutrinos on polarized nucleons, viewed as forward virtual WN scattering, is discussed in a model-independent way based upon the use of a double spectral representation for the invariant amplitudes. In this framework, many of the scaling results of deep-inelastic νN scattering emerge naturally: for example, the linear neutrino energy dependence of the double differential cross section, and for unpolarized, average nucleon targets, its y dependence; the scaling behavior of the various structure functions; and the vanishing of the longitudinal cross section in the scaling limit. This approach is seen to be useful in organizing disparate data from the different scattering regimes. Of particular interest is the derivation of new sum rules for the scaling functions and for various WN total cross sections. (auth)

21418 VECTOR MODEL OF THE WEAK INTERACTIONS. De Rújula, A.; Georgi, H.; Glashow, S.L. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 12: No. 11, 3589-3605 (1 Dec 1975).

We search for a renormalizable gauge theory incorporating our modified weak current. The right-handed quarks participate to give a natural explanation for the nonleptonic $\Delta I = 1/2$ rule. We argue that extra quarks and/or extra leptons are necessary. We focus on a vector-like model involving six different quark "flavors," each in a color triplet: 18 quarks all told. The model also involves a third charged lepton and several massive neutral leptons. We compare the predictions of our model with the conventional (12 quarks) model. Present experimental data are insufficient to discriminate between the two models. We give detailed analyses and predictions concerning charged-current and neutral-current phenomena, including inclusive scattering, scattering of neutrinos by electrons, single-pion production, and neutrino or antineutrino elastic scattering on protons. (auth)

21419 POLARIZED ELECTRON-NUCLEUS SCATTERING AND PARITY-VIOLATING NEUTRAL CURRENT INTERACTIONS. Feinberg, G. (Physics Department, Columbia University, New York, New York 10027). Phys. Rev. D 12: No. 11, 3575-3582 (1 Dec 1975).

The polarization asymmetry in the scattering of polarized electrons from nuclei coming from the interference between electromagnetic interactions, and parity-violating neutral current interactions, is discussed. It is shown how measurements of this asymmetry in various elastic and inelastic electron-nucleus scatterings can be used to determine specific spin and isospin terms in the hadronic neutral current. A specially interesting case would be a measurement in a $0^+ \to 0^-$ excitation, in which the asymmetry is 100 times larger than usual, because the electromagnetic matrix element involves two-photon exchange. (auth)

21420 APPLICATION OF CURRENT-ALGEBRA TECHNIQUES TO SOFT-PION PRODUCTION BY THE WEAK NEUTRAL CURRENT: V, A CASE. Adler, S.L. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 12: No. 9, 2644-2665 (1 Nov 1975).

We apply current-algebra techniques to study the constraints imposed on neutral-current-induced soft-pion production, using as input existing bounds on neutrino-proton elastic scattering and existing data on neutral-current-induced deep-inelastic scattering. In the case of a purely isoscalar weak neutral current, a simple soft-pion argument relates the cross section for threshold (in pion-nucleon invariant mass) weak pion production directly to the cross section for neutrino-proton elastic scattering. Hence, a bound on the latter cross section implies a bound on the former. To apply the method away from threshold and to nonisoscalar neutral currents, we extend a model which we had developed earlier for weak pion production in the (3, 3) resonance region so as to include the low-energy-theorem constraints. Numerical work using the extended model shows that a threshold peak (now attributed to background) in preliminary Argonne data on $\nu + n \to \nu + p + \pi^-$ would have implied a threshold cross section much larger than can be obtained with any neutral current formed solely from members of the usual V, A nonets. We analyze recently reported Brookhaven National Laboratory results for neutral-current-induced soft-pion production under the simplifying assumption of a purely isoscalar V, A neutral current. We find in this case that the magnitude of the Brookhaven observations exceeds the theoretical maximum by more than a factor of 2 unless the assumed isoscalar current either contains a vector part with an anomalously larger gyromagnetic ratio $|g| = |2M_N F_2/F_1|$ or involves the ninth (SU_3 singlet) axial-vector current. A vector part with a large $|g|$ value leads to characteristic modifications in the pion-nucleon invariant-mass spectrum for $M(\pi N) \lesssim 1.4$ GeV, an effect which should be testable in high-statistics experiments. Two other qualitative predictions of isoscalar V, A structures are (i) except for a narrow range of values of g, constructive V, A interference in $\nu + N \to \nu + N + \pi$ implies

constructive interference in $\nu + p \rightarrow \nu + p$ and vice versa, and (ii) if V, A interference is observed in neutral weak processes then (as is well-known) the neutral interaction may make a parity-violating contribution to the pp, ep, and μp interactions. These features may help to distinguish V, A neutral-current coupling from alternative coupling types, which will be discussed in detail in subsequent papers of this series. (auth)

21421 PATTERN OF SCALING VIOLATION IMPLIED BY FIELD THEORIES. Tung, W. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 12: No. 11, 3613-3623 (1 Dec 1975).

The pattern of scaling violation in deep-inelastic scattering implied by renormalizable field theories is studied. A set of model-independent predictions are extracted from a series of model calculations involving both asymptotically free and conventional theories. These are contrasted with the pattern of scaling violation predicted by modified parton models. A procedure for comparing the predictions with experiment is discussed and applied to existing data from the Stanford Linear Accelerator Center. General qualitative agreement is indicated. Crucial tests for the predicted pattern should come from the forthcoming Fermi National Accelerator Laboratory experiments. The possibility of distinguishing the predictions of asymptotically free theories from those of conventional theories by these experiments is found to be untenable due to various uncertainties in the theoretical considerations. (auth)

21422 THEORETICAL INTERPRETATION OF RECENT NEUTRAL CURRENT RESULTS. Adler, S. L. (Inst. for Advanced Study, Princeton, NJ). pp 297-327 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

Work on the structure of the weak neutral current is described covering the V, A and S, P, T cases. (JFP)

21423 PROPOSED RADIOCHEMICAL APPROACH TO THE NUCLEON LIFETIME. Steinberg, R. I.; Maenhaut, W. (Univ. of Maryland, College Park). Lett. Nuovo Cim.; 15: No. 3, 93-96 (17 Jan 1976).

A radiochemical method is discussed which is sensitive to all nucleon decay modes (including $n \rightarrow 3\nu$) and which is capable of setting a limit beyond 10^{27} years for the nucleon lifetime. It appears at the present time that no other transition is as favorable as $^{58}Ni \rightarrow {}^{57}Co$. It seems possible that using a radiochemical technique, one can improve significantly existing knowledge concerning the stability of the nucleon. (JFP)

Strong (General)

Refer also to abstracts 21053, 21399, 21522, 21894, 21896, 21906, and 21913.

21424 (ANL/HEP-CP-75-58, pp 115-124) ERICSON FLUCTUATIONS IN HADRON SCATTERING. Frautschi, S. (California Inst. of Tech., Pasadena, CA). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne, National Lab., Ill. (USA)).

It is shown that there are resonances with high mass and long lives, at the very least, longer than the 10^{-23} second transit time across a hadron. The theoretical and then the experimental approaches to this problem are described. (JFP)

21425 (ANL/HEP-CP-75-58, pp 264-279) SU(4)/Z(2) SYMMETRY OF HADRONS. Oakes, R. J. (Northwestern Univ., Evanston, IL). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Sextet quark models of hadrons based on the symmetry group SU(4)/Z(2) approximately O(6) in which the quarks belong to the fundamental six dimensional representation are discussed. One particularly attractive model is emphasized in which the electromagnetic and weak interactions can be unified into a spontaneously broken U(2) gauge theory that is renormalizable. (auth)

21426 (JINR-D1-5969, pp 439-462) INCLUSIVE MANY-BODY REACTIONS: THERMODYNAMIC MODEL AND LIMITING FRAGMENTATION. Ranft, J. (Karl-Marx-Univ., Leipzig). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

Two models for particle production in inclusive reactions are reviewed: The hypothesis of limiting fragmentation and the thermodynamic model. The foundations of these models are discussed, and the predictions of the models are compared with experimental data on inclusive single particle momentum spectra. Finally, proposals for some experiments on inclusive reactions are collected and discussed. (auth)

21427 CONSTITUENT THEORY OF LARGE-MASS PRODUCTION. Sachrajda, C.T.; Blankenbecler, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 12: No. 11, 3624-3637 (1 Dec 1975).

It is argued that the study of the production of a pair of particles with large invariant mass can provide information on the dynamics of hadronic constituents in a similar way to the study of large-transverse momentum reactions. A general framework for the analysis and interpretation of these reactions is developed in terms of hadron-irreducible subprocesses and the constituent-interchange model. Counting rules are developed that predict the energy and mass dependence of the cross section. In particular, the production of a massive lepton pair or hadron pair in reactions with photon or hadron beams is discussed. A particularly interesting process that is discussed involves the production of a massive hadron pair in electron-positron annihilation. Its importance in measuring properties of generalized structure functions is emphasized. (auth)

21428 COLOR-SYMMETRY BREAKING AND THE BARYON SPECTRUM. II. Capps, R.H. (Purdue University, West Lafayette, Indiana 47907 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 12: No. 11, 3606-3612 (1 Dec 1975).

Recently I proposed that the forces between quarks of two of the colors in the colored-quark model are of shorter range than forces involving quarks of the third color, and showed that if this color-symmetry breaking mechanism is strong, the favored baryon SU(6) representations and parities are 56^+ and 70^-, in agreement with experimental indications. In this paper it it shown that this prediction also results if the symmetry breaking is small, in which case the sign of the symmetry breaking is irrelevant. I discuss a possible experimental way to test the validity of the mechanism and measure the approximate size of the symmetry breaking. A useful list of orthonormal quark-model wave functions of specific energies and symmetries is given. (auth)

21429 SIMPLE INTERPRETATION OF THE MELOSH TRANSFORMATION. Marinescu, N.; Kugler, M. (Department of Nuclear Physics, Weizmann Institute of Science, Rehovot, Israel). Phys. Rev. D 12: No. 10, 3315-3318 (15 Nov 1975).

We discuss a simple and physically transparent derivation of the Melosh transformation. This enables us to investigate several difficulties in the field. (auth)

21430 FIXED WIDE-ANGLE SCATTERING OF ELEMENTARY FERMIONS IN GAUGE THEORIES. Poggio, E.C.; Quinn, H.R. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 12: No. 10, 3279-3290 (15 Nov 1975).

We consider leading logarithmic corrections to the Born amplitude for wide-angle scattering of off-mass-shell quarks through sixth order in non-Abelian gauge theories. We review first the situation for the case of Abelian theories, where the leading logarithmic contributions can be summed to all orders, yielding a simple exponential form $\exp(-K\ln^2 t)$. We find that the non-Abelian theory through sixth order does not yield a form which corresponds to the perturbation expansion of an exponential. This is a consequence of the similar result for form-factor corrections which has been reported elsewhere. (auth)

21431 WILSON'S QUARK CONFINEMENT AND THE ORIGIN OF THE OKUBO-ZWEIG-IIZUKA RULE. Dosch, H.G. (Universität Heidelberg, Institut für Theoretische Physik, Heidelberg, Germany); Müller, V.F. Phys. Rev. D 12: No. 10, 3343-3345 (15 Nov 1975).

A dynamical derivation of the Okubo-Zweig-Iizuka rule for decay processes involving nonscalar particles is given, on the basis of Wilson's lattice gauge field theory. (auth)

21432 SUPERSYMMETRY OF HADRON MULTIPLETS. Hwa, R.C. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403); Lam, C.S. Phys. Rev. D 12: No. 11, 3730-3737 (1 Dec 1975).

The supersymmetry algebra of Wess and Zumino has been generalized to incorporate explicitly the baryon-number operator. Constraints on the algebraic structure due to the finite dimensionality of its representations have been determined. In the rest frame where the supersymmetry generator has only two components, it is shown that an irreducible representation cannot have more than three adjacent baryon numbers. The octet representations in the (B,J_3) space for various SU(3) states are shown to accommodate most of the prominent hadrons. The product

representation of two octets has been reduced to an irreducible octet component, and the consequences on the coupling constants have been determined. The implication on the couplings among the physical hadrons is discussed. (auth)

21433 MULTIPARTICLE DISTRIBUTIONS IN A FIXED RANGE OF RAPIDITY. Chen, M. (Physics Department, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 12: No. 11, 3708-3710 (1 Dec 1975).

A new set of multiparticle distributions is proposed as a simple and useful tool to investigate correlations and scaling properties. These distributions from the reaction $p + p \rightarrow \pi^+ +$ anything at 100 GeV are presented and discussed. (auth)

21434 ANALYSIS OF PARTICLE PRODUCTION AT LARGE TRANSVERSE MOMENTUM. Blankenbecler, R.; Brodsky, S.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Gunion, J. Phys. Rev. D 12: No. 11, 3469-3487 (1 Dec 1975).

An analysis of large-transverse-momentum data is carried out using local exponents which characterize the dependence of the cross sections on p_T and $\epsilon =$ (missing mass)$^2/s$. The results of this effective-power analysis allow any model to be critically compared to the data in a simple but meaningful way. Selected models are examined. A survey of the features of the constituent interchange model (CIM) is given for inclusive scattering, and some special features for electromagnetic processes are discussed. The CIM can explain, in a simple way, not only the behavior of the local exponents but also their specific values for each particle type using the quark-counting rules. Quasielastic peaks in the ϵ distribution are observed for the difference between particle and antiparticle production ($p - \bar{p}$, $K^+ - K^-$) which are consistent with expectations. Further crucial tests of the CIM are discussed. (auth)

21435 BEHAVIOR OF THE MULTIPLICITY WITH LARGE PERPENDICULAR MOMENTUM TRANSFERRED TO THE LEADING PROTON AS PREDICTED BY MULTIPLE QUARK SCATTERING. Kanofsky, A.S. (Department of Physics, Lehigh University, Bethlehem, Pennsylvania 18015 and Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 12: No. 9, 2632-2638 (1 Nov 1975).

The previous calculation used to explain the rise in multiplicity with increasing p_t given to the leading proton has been extended to include higher order quark-quark scattering terms. It is found that another abrupt rise in the multiplicity can be expected at $p_t \sim 1.5$ GeV/c where third-order inelastic scattering terms begin to dominate over second-order terms. (auth)

21436 SUPPRESSION FACTORS IN CHARMED-PARTICLE PRODUCTION. Barger, V. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Phillips, R.J.N. Phys. Rev. D 12: No. 9, 2623-2627 (1 Nov 1975).

Quantitative estimates are presented for the production of particles with nonzero charm number, based on the close dynamical similarity with associated production of strange particles, and using the idea that symmetry breaking comes mostly through trajectory displacements. We find that cross sections may be realized at the level of 1 nb for two-body reactions and 60 nb for inclusive reactions in the triple-Regge region. Crucial elements in the calculations are the negative intercepts of the charmed Regge trajectories, and kinematic suppression through the t_{min} cutoff. (auth)

21437 CHIRAL INVARIANCE IN A BAG THEORY. Chodos, A.; Thorn, C.B. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 12: No. 9, 2733-2743 (1 Nov 1975).

We study phenomena that involve surface fluctuations of a bag by introducing unconfined $\vec{\pi}$ and σ fields which interact with the bag only at the surface. The resulting theory is chirally symmetric. We find exact classical solutions to the equations of motion, which have the "hedgehog" property that $\vec{\pi}(x) = g(r)\hat{r}$. In addition, we study other classical solutions perturbatively, and estimate the values of the Δ width and of F_π predicted by our model. There are no free parameters except the bag constant B, which sets the over-all scale. (auth)

21438 HADRON MASS RELATIONS IN A CHARMED QUARK MODEL WITH BROKEN SU(8) SYMMETRY. Hendry, A.W.; Lichtenberg, D.B. (Physics Department, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 12: No. 9, 2756-2760 (1 Nov 1975).

It is assumed that charmed hadrons exist, and, together with the usual hadrons, can be classified in representations of SU(8). Hadron masses are assumed to arise from quark masses plus two-body interactions between quarks. Mass relations among the hadrons are obtained. It is estimated that charmed vector mesons have masses about 2 GeV and that charmed baryons have masses between 2.2 and 5 GeV. (auth)

21439 GENERAL THREE-SPINOR WAVE FUNCTIONS AND THE RELATIVISTIC QUARK MODEL. Henriques, A.B.; Kellett, B.H.; Moorhouse, R.G. (Department of Natural Philosophy, University of Glasgow, Glasgow, Scotland). Ann. Phys. (N.Y.) 93: No. 1, 125-151 (5 Sept 1975).

The complete set of three particle relativistic spinors is constructed in a set of evidently covariant forms classified into irreducible representations of the permutation group, S_3, for use in the three quark model of baryons. A few of the various types of three quark spinor functions are illustrated by evaluating their electromagnetic current interactions using the four dimensional oscillator models of Feynman, Kislinger, and Ravndal and Lipes for the spatial part of the wave function; one of our types gives markedly better results for nucleon electromagnetic form factors than the type corresponding to the original models of these authors, but problems, largely associated with the four dimensional oscillator, remain in the electromagnetic transitions to higher baryon resonances. (auth)

21440 DUAL RESONANCE MODEL INCORPORATING TWO DIFFERENT PARENT REGGE TRAJECTORIES IN THE SAME CHANNEL. Frampton, P.H.; Rabl, V. (Department of Physics, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 12: No. 10, 3214-3220 (15 Nov 1975).

A four-particle dual model is constructed with two different Regge trajectories in both the s and t channels. The amplitude is crossing-symmetric, has residues that are polynomial of correct order, and has full Regge behavior. In a certain limit it becomes the Euler B function. The multiparticle generalization of the present model will be relevant to construction of hadron models with realistic mass spectra. (auth)

21441 RELATIVISTIC TREATMENT OF THE QUARK-CONFINEMENT POTENTIAL. Gunion, J.F. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260); Li, L.F. Phys. Rev. D 12: No. 11, 3583-3588 (1 Dec 1975).

We discuss the spectrum resulting from a relativistic treatment of a linear confinement potential. We employ Klein-Gordon and Dirac wave equations regarding the linear potential as a Lorentz scalar. (auth)

21442 VECTOR-MESON PRODUCTION AT LARGE TRANSVERSE MOMENTUM. Combridge, B.L. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 12: No. 9, 2893-2902 (1 Nov 1975).

This paper considers possible extensions of the Landshoff-Polkinghorne quark-fusion model, for the production of large-p_T pseudoscalar mesons, to include the vector-meson nonet. The relative multiplicities of pseudoscalars, taking vector-meson decay into account, are calculated in two models. The leptonic decays of the ρ^0, ω, and ϕ give rise to a predicted e^+/π^+ ratio of about $5 \cdot 10^{-5}$ in both models. Qualitative features of the models are discussed in the light of existing data on the structure of large-transverse-momentum events. (auth)

21443 NOTE ON MASS ENHANCEMENTS AND THE GOLDSTONE-PAIR MECHANISM. Dothan, Y. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 12: No. 9, 2844-2850 (1 Nov 1975).

The irreducible components of the $\frac{1}{2}^+$ baryon mass matrix and the 0^- meson mass-squared matrix are calculated and compared with the Li-Pagels relations. The Li-Pagels relations predict correctly signs and orders of magnitude but most of them are off by non-negligible factors. An exception is the relation

$$\frac{(m_p - m_n) + 2(m_{\Sigma^+} - m_{\Sigma^-}) + (m_{\Xi^0} - m_{\Xi^-})}{m_\Xi - m_N} = -\frac{3(m_{K^+}{}^2 - m_{K^0}{}^2) \cdot 2\sqrt{3}\,(m_\eta{}^2 - m_{\pi^0}{}^2)\sin\beta\cos\beta}{2m_K{}^2 + m_{\pi^0}{}^2 - 3m_\eta{}^2}$$

which is satisfied quite well. The angle β is the η-π^0 mixing angle. (auth)

21444 COMMENT ON CHARMONIUM BOUND-STATE CALCULATIONS USING POTENTIALS. Goldman, T.; Yankielowicz, S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 12: No. 9, 2910-2913 (1 Nov 1975).

We show that using the Dirac equation to calculate quark bound states can give rise to significantly different eigenspectra than those obtained by using the same potential in the Schrödinger equation, even when $\langle v^2/c^2 \rangle$ is small. The origin of this effect is identified and discussed. (auth)

21445 MASS FORMULAS, STRONG GRAVITY, AND SCALAR-TENSOR UNIVERSALITY. Vasavada, K.V. (Department of Physics, Indiana-Purdue University, Indianapolis, Indiana 46205). Phys. Rev. D 12: No. 9, 2918-2921 (1 Nov 1975).

We show that tensor dominance of the stress tensor and a scalar-tensor universality postulate lead to values of the D/F ratio and the coupling constants of the f meson and Pomeron to nucleons in very good agreement with experiments. (auth)

21446 HADRONIC ELECTRONS. Wolfram, S. (Eton Coll., Berkshire, Eng.). Aust. J. Phys.; 28: No. 5, 479-487(Oct 1975).

A new form of high energy electron–hadron coupling is examined

with reference to the experimental data. The electron is taken to have a neutral vector gluon cloud with a radius $\sim 10^{-18}$m. This is shown to be consistent with measurements on $e^+e^- \rightarrow e^+e^-$ and $g_e - 2$. At low energies, only photons couple to the gluons, but at higher energies "evaporation" then "boiling" of ω and ϕ occurs, allowing strong interactions. The model yields accurate predictions for the form of the rise in $R = \sigma(e^+e^- \rightarrow h)/\sigma(e^+e^- \rightarrow \mu^+\mu^-)$. Arguments are given for the order of magnitude of m_e and for the lack of a permanent meson cloud in leptons. Strong interaction selection rules forbid a contribution to $\pi^0 \rightarrow e^+e^-$, and interference with the one-photon channel produces minimal scaling violation in eN processes at present energies. The constant value of $\sigma(e^+e^-)/\sigma(\bar{p}p)$ is correctly predicted and evidence from high energy pp interactions is also cited. The Ψ particles are interpreted as e^+e^- resonances in the evaporation region, and their properties are generated correctly. Predictions are given for the behavior of $\sigma(e^+e^-)$ at high energies. (auth)

21447 NUCLEAR FORCES AND THE QUANTIZATION OF M.I.T. BAGS. Fairley, G. T.; Squires, E. J. (Univ. of Durham, Eng.). Acta Phys. Pol., Ser. B; B6: No. 6, 893-905(1975).

The origin of interhadronic forces in the M.I.T. bag model is discussed and one is led to consider a method of quantization in which the boundary of the bag is a quantum variable. (auth)

21448 KINEMATICAL BASIS FOR POWER FORM FACTORS. Kamath, S. G.; Gupta, M.; Chakrabarty, S.; Mitra, A. N. (Univ. of Delhi). Pramana; 5: No. 3, 144-153(Sep 1975).

A kinematical basis is proposed for form factors of the power type associated with multiple derivative couplings, on the basis of a Lorentz contraction effect on the external momenta involved in the transition matrix elements for mesons and baryons as appropriate quark composites. The argument (due to Licht and Pagnamenta) which applies separately to the Breit and c.m. frames for a decay matrix element provides a formal theoretical justification for the ad hoc power form factors used by the Delhi group in a series of applications to hadronic processes over the past few years. The radius of interaction finds a natural place in this description simply from dimensional considerations, and its rather small magnitude, less than 0·5F, estimated from fits to the data indicates a relatively small role played by structure effects. The Breit frame form factors, which work somewhat better than the c.m. frame ones (effectively used in the earlier studies), give a rather impressive set of fits to the baryon decays in the (L + 1) wave (consistently for both vertical and horizontal) and the (L − 1) wave (mainly horizontal). The mesonic decays, the data for which are available mostly for the (L + 1) wave, are also fitted with an equal degree of consistency without any extra assumptions. (3 tables, 1 figure) (auth)

21449 M.I.T. BAG MODEL. Johnson, K. (Massachusetts Inst. of Tech., Cambridge). Acta Phys. Pol., Ser.; B6: No. 6, 865-892(1975).

The M.I.T. bag model for hadron structure is reviewed. (auth)

21450 LARGE TRANSVERSE MOMENTA IN INCLUSIVE HADRONIC REACTIONS AND ASYMPTOTIC SCALE INVARIANCE. Miralles, F.; Sala, C. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 15: No. 3, 75-79(17 Jan 1976).

The main aim of large-transverse momentum physics is to give information about the internal structure of hadrons. It is assumed that in the large transverse momentum limit scale invariance becomes important. An inclusive reaction among scalar particles is considered. Photoproduction is also studied, as well as the $pp \rightarrow \pi$ + anything interactions for predictions from various assumptions about the compositeness of hadrons. (JFP)

Strong (Baryon No. = 0)

Refer also to abstract 21525.

21451 (ANL/HEP-CP-75-58, pp 1-18) LOST STATES OF THE QUARK MODEL AND HOW TO FIND THEM. Hey, A. J. G. (Univ. of Southampton, Eng.). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The two-quanta-excited quark states for mesons are studied using an explicit SU(6) model as a guide. A possible understanding emerges of some of the experimentally undetected multiplets, and the calculations further suggest that the decays of N equals 2 mesons may provide a prolific source of some of the elusive N equals 1 mesons such as the A_1. (auth)

21452 (ANL/HEP-CP-75-58, pp 39-44) A_1 PROBLEM, AND SHOULD SU(3) MULTIPLETS BE COMPLETE. Kane, G. L. (Fermi National Accelerator Lab., Batavia, IL). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

A review is given of the A_1 problem and the possible SU(3) multiplets including reasons for expecting axial vector particles, evidence against the existence of the A_1, implications of the absence of the A_1 for sum rules, the quark model, nu reactions, etc., and SU(3) related axial vector states. (JFP)

21453 (ANL/HEP-CP-75-58, pp 45-63) STATUS OF THE 0^+ NONET. Morgan, D. (Rutherford Lab., Chilton, Eng.). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The phenomenological case is presented for a complete normal scalar nonet comprising delta(976) (I equals 1), kappa(1250) (I equals ½), S*(1000) and epsilon('1200') (I equals 0), nonideally mixed (theta/sub S/ approximately 65^0 +- 5^0 as against theta/sub Ideal/ approximately 35^0), but seemingly respecting Zweig's rule in its hadronic decays. These decays, which go almost entirely to two-body S-wave final states, exhibit the inherent kinematic complications in a simple way. This is especially so for the delta and S* systems for each of which the resonance pole occurs just below the threshold of the strongly coupled K anti K channel. In the I equals 0 system, to which the S* couples, the 'background' itself manifests resonance activity whose classification requires a scheme for describing overlapping resonances. The only natural prescription appears to be that of 'adding phase shifts' (strictly, multiplying Jost-functions); on applying it to the residual I equals 0 dynamics the epsilon (900) and epsilon'(1250) effects coalesce into a single broad elastic resonance centered at or above 1100 MeV. This completes the tally of nonet candidates to whose hadronic decays a conventional SU (3) analysis is then applied. Some wider bearings of the resulting nonideal nonet structure are mentioned. (auth)

21454 (ANL/HEP-CP-75-58, pp 151-164) RESONANCE SUPERPOSITION CONSIDERATIONS FOR e^+e^- AND anti pp ANNIHILATIONS. Margolis, B. (McGill Univ., Montreal). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The possibility is considered that above the low mass discrete spectrum a statistical superposition of resonances is in order in nonexotic situations is considered. An attempt is made to estimate through semi-classical angular momentum arguments the energy range for annihilation reactions to be capable of establishing an approximation of thermodynamic equilibrium. The reaction anti p + p yields anything and using a generalized vector dominance picture the reaction $e^+ + e^-$ yields hadrons are considered. The main emphasis is on a statistical description of formation reactions of the type a + b yields M yields anything and a comparison of the experimental data for the two studied reactions. The cross sections are mainly considered. (JFP)

21455 (ANL/HEP-CP-75-58, pp 165-171) EXOTIC N anti N RESONANCES. Rosner, J. L. (Univ. of Minnesota, Minneapolis). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Some experimental suggestions for detecting exotic N anti N resonances were previously reviewed. Some additional possibilities not directly related to bump hunting are mentioned. The discussion includes the magnitude of Reggeon-exchange contributions to baryon-antibaryon total cross sections, the smallness of S-wave annihilation rates, and the precision of symmetry description of anti NN annihilations at rest. (JFP)

21456 (ANL/HEP-CP-75-58, pp 248-263) COLOR MODELS FOR THE psi's: A CRITICAL REVIEW. Peccei, R. D. (Stanford Univ., CA). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The motivation for supposing that the psi particles are related to color excitations is discussed, and a variety of recently proposed color models are critically examined. Particular attention is paid to the experimental predictions of the various models and possible experimental, and theoretical, difficulties are pointed out for each model. (auth)

21457 (ANL/HEP/PR-75-71) INSTABILITY OF COLLECTIVE STRONG-INTERACTION PHENOMENA IN HADRON PRODUCTION

AS A POSSIBLE ORIGIN OF THE WEAK AND ELECTROMAGNETIC INTERACTIONS. Arnold, R. C. (Argonne National Lab., Ill. (USA)). Dec 1975. Contract W-31-109-Eng-38. 21p. Dep. NTIS $3.50.

A systematic calculus of long-range Regge cut effects in multiparticle production is constructed in the form of an infrared-divergent stochastic field theory. Total cross sections and two-body overlap integrals in such a theory may depend very sensitively upon internal quantum-numbers of incident particles, resulting in a strong symmetry breaking at ultra-high energies. Such symmetry violations will influence low energy processes through dispersion relations, and a bootstrap of weak interactions becomes possible. A rough analytic estimate of the scale of thresholds for such effects yields a BCS-type gap equation, which expresses the scale of weak and electromagnetic couplings in terms of purely strong-interaction parameters. (auth)

21458 (JINR-D1-5969, pp 564-578) MULTICLUSTER MODELS OF MULTIPERIPHERAL TYPE. Bebel, D.; Biebl, K. J.; Ebert, D. (Humboldt-Univ., Berlin). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

Reggeized multicluster models are constructed which can be interpreted as generalized ABFST-models with reggeized pion links and elastic and inelastic two-pion irreducible input cross sections. Summing up the multicluster graphs by a Bethe-Salpeter equation the output trajectories for input kernels with different high energy tails are discussed. (auth)

21459 (JINR-D1-5969, pp 588-594) FUNCTIONAL BOND METHOD FOR SOLUTION OF STATIC MODEL EQUATIONS. Meshcheryakov, V. A.; Rerikh, K. V. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21460 (JINR-D1-5969, pp 595-603) THRESHOLD SUM RULES FROM UNITARITY. Kwiecinski, J. (Inst. of Nuclear Physics, Krakow). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

It is shown, using the t-channel unitarity condition, that the reduced partial wave $\pi\pi$ scattering amplitude evaluated at threshold for Rel $\geq \frac{1}{2}$ vanishes, and it has a known first derivative with respect to angular momentum 1 at the point $1 = -\frac{1}{2}$. These properties imply the sum rule constraints for the crossed channel absorptive part for t fixed at threshold. The sum rules are analyzed for $\pi\pi$ scattering. Their generalization to other processes is also discussed. (auth)

21461 (LBL-4276) NEW SPECTROSCOPY. Trilling, G. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 86p. (CONF-750754-1). Dep. NTIS $6.00.

From Summer Institute on Particle Physics; Stanford, California, United States of America (USA) (21 Jul 1975).

Review lectures are presented on the properties and decay of psi(3105) and psi(3695). (JFP)

21462 ANGULAR DISTRIBUTIONS IN THE DECAY $\psi' \to \psi\pi\pi$. Cahn, R.N. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 12: No. 11, 3559-3563 (1 Dec 1975).

A general analysis of the decay amplitudes for $\psi' \to \psi\pi\pi$ is presented. Angular distributions are calculated for $\psi' \to \psi\pi^+\pi^- \to \mu^+\mu^-\pi^-\pi^+\pi^-$ in terms of partial-wave amplitudes diagonal in orbital and spin angular momentum. The determination of the partial-wave amplitudes for $\psi' \to \psi\pi\pi$ may yield the difference between s-wave and d-wave π-π phase shifts in the $I = 0$ channel if there is sufficient π-π d-wave present to produce measurable interference. The angular distributions for decays of the form $\psi' \to VPP$ follow, *mutatis mutandis*, although VP interactions may prevent the determination of the PP phase shifts. Determination of the partial-wave amplitudes will test the validity of chiral-symmetry models for the $\psi'\to\psi\pi\pi$ decay. (auth)

21463 SCALAR-MESON DOMINANCE MODEL IN THE DECAY $\psi' \to J + 2\pi$. Harrington, B.J.; Park, S.Y.; Yildiz, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 12: No. 9, 2765-2767 (1 Nov 1975).

A scalar-meson dominance model in which the ϵ is coupled derivatively to pions is constructed to study the decay ψ' (3684) $\to J$ (3095) $+ 2\pi$. This phenomenological approach leads to both an invariant pion mass spectrum in accord with the preliminary results from SLAC and an approximate value of the quark-gluon coupling (α_s) of 0.2–0.3. We extend the model to include the pion decay modes of the ψ'' (4150). (auth)

21464 WHY THE PSEUDOSCALAR MESON MIXING ANGLE IS $-10°$. Isgur, N. (Department of Physics, University of Toronto, Toronto, Ontario, Canada). Phys. Rev. D 12: No. 11, 3770-3774 (1 Dec 1975).

We propose a simple approach to the problem of mixing in nonets which leads to an understanding of the related nature of both the "ideal" mixing angle of 35° found for the vector and tensor mesons and the "nonideal" mixing angle of -10° found for the pseudoscalar mesons. We argue that the pseudoscalar meson mixing angle is "nonideal" because of a near degeneracy in the masses of the strange and nonstrange pseudoscalar mesons. As by-products we predict that more massive nonets will be nearly ideal and that, if charmed quarks "exist," the low-lying charm-anticharm mesons will be very narrow. (auth)

21465 RELATIVISTIC PARTIAL-WAVE ANALYSIS FOR THREE-MESON SYSTEMS. I. Lock, J.A. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. D 12: No. 10, 3319-3326 (15 Nov 1975).

In previous Faddeev-type treatments of three-meson resonant systems, the Galilean two-body relative momentum has been employed in relativistic partial-wave analyses carried out in the three-body center-of-mass frame. However, this leads to difficulties in the interpretation of the Galilean form as the proper relativistic two-body relative momentum. We show that these difficulties are overcome if the two-body internal momentum is defined so as to have both its magnitude and direction independent of the Lorentz frame in which it is evaluated, analogous to the identical property of the Galilean relative momentum for various Galilean frames. Using such a relativistic version of the internal momentum, we carry out, as an example, a partial-wave analysis of the minimal-dynamics K-matrix equations using the Omnès coupling scheme. Finally we apply our results to the $I = 0$ channel of the three-pion system. (auth)

21466 CP-VIOLATING RELATIVISTIC QUARK MODELS AND THE K^0-$\bar{K}^0$ SELF-ENERGY MATRIX. Flamm, D. (Institut für Theoretische Physik der Universität Wien, Wien, Austria); Kielanowski, P.; Morales, A.; Nunez-Lagos, R.; Guillen, J.S. Phys. Rev. D 12: No. 9, 2684-2691 (1 Nov 1975).

With a relativistic quark model which is based on the Bethe-Salpeter equation the K^0-$\bar{K}^0$ self-energy matrix is calculated for the CP-violating models of Glashow, Oakes, and Das. For the first two models the kaon mass difference is in reasonable agreement with experiment. The CP-violating angles are determined from a least-squares fit of the theoretical values of Reϵ, η_{+-}, and η_{00} to the experimental data. While the model of Glashow gives good agreement with experiment, no reasonable fit can be achieved for the models of Oakes and Das. (auth)

21467 RESONANCE INTERPRETATION OF THE DECAY OF ψ' (3.7) INTO ψ (3.1). Schwinger, J.; Milton, K.A.; Tsai, W.; DeRaad, L.L. Jr. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 12: No. 9, 2617-2619 (1 Nov 1975).

It is pointed out that the theoretical difficulty implied by the large coupling constant required for a local interaction of $\pi^+\pi^-$ with ψ (3.1) and ψ' (3.7) is eliminated in an ϵ model of the decay. To assist in an experimental decision between the two alternatives, the pion spectra for the two models are presented, with several choices of the ϵ parameters. Related remarks are made about the decay ρ' (1600) $\to \rho$ (770) $+ \pi^+\pi^-$. (auth)

21468 UNITARITY AND PARTIAL WIDTH FOR $\phi \to 3\pi$. Pasupathy, J. (Tata Institute of Fundamental Research, Homi Bhabha Road, Bombay 400005). Phys. Rev. D 12: No. 9, 2929-2931 (1 Nov 1975).

It is shown that absorptive contributions to $g_{\phi\rho\pi}$ coming from $\phi \to K\bar{K} \to 3\pi$ may account for the observed magnitude of Γ ($\phi \to 3\pi$). Two complementary calculations, one based on the Gell-Mann–Sharp–Wagner model and the other based on partial-wave unitarity, are presented. It is argued that ψ (3105) and ψ' (3695) are especially narrow since similar absorptive corrections are absent. (auth)

21469 QUARK SELF ENERGY AND A NEW WAVE EQUATION FOR THE MESONS. Stuller, R. L. (Imperial Coll. of Science and Tech., London). Acta Phys. Pol., Ser. B; B6: No. 6, 907-917(1975).

A model of colored quarks interacting through non Abelian vector gauge potentials is analyzed. Conditions are described under which the self consistently determined quark mass equals infinity. A covariant bound state equation for color singlet mesons is derived which is three dimensional. The Regge trajectories predicted by such a model cannot rise indefinitely. (auth)

21470 THEORY AND PHENOMENOLOGY OF COLORED QUARK MODELS. Close, F. E. (CERN, Geneva). Acta Phys. Pol., Ser. B; B6: No. 6, 785-821(1975).

A general introduction to colored quark models is given and their phenomenology is described with particular reference to the new particles. It is shown that there are essentially three types of color models with color excitation when the color group is SU(3) —Han–Nambu, Greenberg and a model which has the same charges as that of Tati and which can be thought of as the Gell-Mann color scheme with excitation of the color degrees of freedom. Particular attention is paid to the four problems of color models for ψ phenomenology —the radiative decays, the G parity conservation, the lack of deep inelastic threshold phenomena and the apparent discovery of dileptons at SPEAR. (auth)

21471 DIFFICULTIES FOR SU(N) QUARK MODELS OF THE NEW PARTICLES. Colglazier, E. W. (Rutherford High Energy Lab., Chilton, Eng.); Barnes, K. J.; Hey, A.J.G.; Zia, R.K.P. Acta Phys. Pol., Ser. B; B6: No. 6, 823-829(1975).

If preliminary experimental results on the new particles are confirmed (primarily the $\psi\eta$ decay of the ψ'), and if conventional theoretical prejudices are accepted, it is shown that Harari's SU(6) model is the minimal N-quark model (with hidden color) which can accommodate these constraints. (auth)

21472 INVESTIGATION OF PION–KAON ELASTIC SCATTERING VIA FORWARD AND BACKWARD DISPERSION RELATIONS, AND PION–PION ELASTIC SCATTERING USING FORWARD DISPERSION RELATIONS. Weiss, E. J. Philadelphia; Temple Univ. (1975). 144p. University Microfilms Order No. 75-28,257. Thesis (Ph. D.).

Single variable once-subtracted dispersion relations are written for both pion kaon elastic scattering amplitudes and pion pion elastic scattering amplitudes. The formulation of the dispersion relations has several advantages over the other approaches: the approach can be used on a wide variety of problems; total I-spin amplitudes are used, which avoids any approximation in implementing crossing; integrations are over physical regions; all integrals are put in manifestly convergent form. With these features, it is hoped to perform a more exacting test of the ability of crossing, unitarity, and analyticity to generate physically realistic amplitudes with single variable dispersion relations. By truncation of a partial wave expansion and the use of elastic unitarity integral equations, believed good below 1 GeV, are formulated that are readily solved by the N/D technique. The potential is evaluated using results from experiment. While for the exotic channels good agreement with experiment is obtained, the low lying resonances characteristic of both scattering processes are not present in the solutions without CDD-poles. Thus, one concludes that these resonances are unstable bound states of higher threshold reactions. (Diss. Abstr. Int., B)

21473 ELECTRON–POSITRON ANNIHILATION TO HADRONS AND COLOR SYMMETRIES OF ELEMENTARY PARTICLES OR THE OUTLOOK FOR COLOR: GRAY OR ROSY. Greenberg, O. W. (Univ. of Maryland, College Park). pp 71-114 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

Several versions of the color model are surveyed, and the use of this model to account for the recently discovered PSI resonances is discussed. The origin of color is discussed recalling the successes of the quark model, in particular, the symmetric quark model, in accounting for the properties of baryons. The variety of possible color models, qualitative features, problems particularly that of radiative decays, and some specific color models proposed to account for present data on the PSI are discussed, and experimental predictions characterizing the different models are given. (JFP)

21474 PARTICLES, FORCES, AND THE NEW MESONS. Pati, J. C. (Univ. of Maryland, College Park). pp 235-296 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

The treatment of particles, forces, and the new mesons includes the family of fundamental fermions, minimal and maximal symmetries for a single coupling constant, masses of gauge particles in the minimal model with color as a classification symmetry, and experimental consequences. (JFP)

21475 TRANSPORT AND HYDRODYNAMIC ASPECTS OF MULTIPARTICLE PRODUCTION. Cooper, F. (Yeshiva Univ., New York); Sharp, D. H. pp 419-441 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

It is noted that one can pass directly from quantum field theory to a hydrodynamic description. It is found that when pions are produced in a coherent quantum state, the hydrodynamics properties of the pion field are those of an ideal fluid. It is also verified, for pion production by a classical source, that the hydrodynamic fluid velocity is equal to the particle velocity and that one can introduce a formal entropy. These results are applied to study the effect of source geometry on the predictions of the Landau model (JFP)

21476 RECENT RESULTS FOR e^+e^- ANNIHILATION AT SPEAR. Lynch, H. L. (Stanford Univ., CA). pp 1-20 of Theories and Experiments in High-energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientists meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

The discussion covers properties of the psi (3105) and psi (3695) resonances, upper limits for the production of other such resonances in the 3.2 to 5.9 GeV, and some structure at 4.1 GeV. Concentration is placed on experimental facts. (JFP)

21477 FREDHOLM APPROXIMANTS FOR POTENTIAL SCATTERING. Sharma, M. L.; Bondyopadhyay, D. (Univ. of Delhi). Pramana; 5: No. 5, 260-267(Nov 1975).

An approximate method based on Fredholm approximants is used to solve Lippmann-Schwinger equation for s-and p-wave Yukawa and s-wave exponential potential scattering problems. The method is then applied to a problem of π-π scattering involving the use of a well known equivalent potential. The equation for partial wave amplitudes is solved to generate the first three π-π resonances, ρ, f_0, and g, in a self-consistent manner. (2 tables, 2 figures) (auth)

21478 PHENOMENOLOGICAL DISPERSION THEORY OF pp, $\bar{p}p$ FORWARD SCATTERING. Dumbrajs, O. (Univ., Warsaw); Staszel, M. Fortschr. Phys.; 23: No. 7, 399-429(1975).

A review is given of the present state of experimental and theoretical knowledge of the proton-proton and antiproton-proton forward scattering, with special attention to applications of phenomenological dispersion theory in elucidating this interaction. The topics covered include the treatment of unphysical region, low energy parametrizations, dispersion relation calculations of the real parts and the meson-nucleon coupling constants, analyses of the data by recently developed numerical analytic continuation techniques, high energy phenomenology, and evaluation of sum rules. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 21292 and 21323.

21479 (ANL/HEP-CP-75-58, pp 28-38) SOME RESULTS FROM THE 4.2 K^-p EXPERIMENT AT CERN. Hemingway, R. J. (CERN, Geneva). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Results from preliminary partial wave analyses of the reactions pi^-p yields anti $K^0pi^+pi^-n$ and K^-p yields $pi^+pi^-pi^0$LAMBDA^0 at 4.2 GeV are presented. These analyses are important in the search for the missing I equals $\frac{1}{2}$ and 1 members of the J/sup P/ equals 1^+ nonet, the Q and A_1, respectively. SIGMA(1375) production in both charged and neutral states is noted. Although the results are preliminary, it is evident that 1^+ states exhibiting narrow resonance structure are not strongly produced in the data. (JFP)

21480 (ANL/HEP-CP-75-58, pp 296-308) CURRENT STATUS OF BARYON SPECTROSCOPY. Wali, K. C. (Syracuse Univ., NY). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The basic ideas of some of the current models and the experimental numerical comparisons are discussed briefly. Included are realistic or constituent quark models, experimental comparison, the experimental and theoretical basis for the assignments, algebraic quark models, and confinement schemes. (JFP)

21481 (ANL/HEP-CP-75-58, pp 343-351) HOW TO IDENTIFY RESONANCES ABOVE THE PHASE-SHIFT ANALYSES REGION. Yokosawa, A. (Argonne National Lab., IL). 1975).

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Interesting regularities are observed in the pi p backward

elastic-scattering data at intermediate energies with respect to the effect of resonances. In addition, the reaction process is found to be peripheral. It is pointed out that one should be able to determine the properties of resonances above the region in which the phase-shift analyses were performed. (auth)

21482 (JINR-D1-5969, pp 510-531) CONSIDERATION OF THE MEDIUM ENERGY RANGE IN DISPERSION SUM RULES AND POLARIZATION REVERSAL IN HIGH-ENERGY PION–NUCLEON SCATTERING. Aznauryan, I. G.; Solov'ev, L. D. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21483 (JINR-D1-5969, pp 532-538) REGGE THEORY FOR PION–NUCLEON SCATTERING AND FESR FOR PARTIAL WAVES. Brandt, W.; Kaschluhn, F. (Institut fuer Hochenergiephysik, Berlin). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The parity- and isospin-conserving partial-wave amplitudes for πN interactions in the forward and backward directions, dominated by t- and u-channel Regge poles respectively, are considered. The nucleon mass and coupling constant are determined. Also the phase shift and the zero, Roper, and 1750-MeV resonances are found. (JFP)

21484 (ORO-3992-251) TOPOLOGICAL DUAL BOOTSTRAP MODEL AND HADRON COLLISIONS. Chiu, C. B.; Hossain, M.; Tow, D. M. (Texas Univ., Austin (USA). Center for Particle Theory). Jan 1976. Contract AT(40-1)-3992. 33p. Dep. NTIS $4.00.

The dual bootstrap model with symmetry breaking and with unequal cylinder and planar couplings is investigated up to the topological cylinder level. Regge intercepts and mixing angles are calculated. Meson-nucleon total cross sections were derived and numerically calculated for p/sub Lab/ from 10 GeV/c to 50 GeV/c. Also calculated are the K/sub ch//pi/sub ch/ multiplicity ratio. All these are in reasonable agreement with data. The work is compared and contrasted with those of Chew-Rosenzweig and of Schmid and collaborators. (auth)

21485 ABSORPTION WEAKENING IN PRODUCTION OF HIGHER-MASS STATES. Williams, P.K. (Department of Physics, Florida State University, Tallahassee, Florida 32306). Phys. Rev. D 12: No. 11, 3572-3574 (1 Dec 1975).

The rather precipitous weakening of absorption observed in $\pi N \to \pi\pi N$ for increasing masses of the produced dipion system is explained within the context of the absorption model by combining a Born-term form factor of increasing steepness with absorption of decreasing range. (auth)

21486 NEUTRON ELECTRIC DIPOLE MOMENT CALCULATION FOR A PHENOMENOLOGICAL MODEL WITH T VIOLATION IN THE STRONG INTERACTION. Clark, R.B.; Randa, J. (Department of Physics, A&M University, College Station, Texas 77843). Phys. Rev. D 12: No. 11, 3564-3571 (1 Dec 1975).

The Sudarshan-Bryan-Gersten model for T violation in the strong interaction is used to calculate the electric dipole moment of the neutron. The method of sidewise dispersion relations is used with the absorptive part of the amplitude arising from the three-particle lepton-antineutrino-nucleon intermediate state which is the lowest-order nonvanishing contribution allowed by the model. The phenomenological couplings are taken from the model. The only free parameter appearing in the calculation is the range of the dispersion relation integral which is taken equal to that used by Drell and Pagels in their successful neutron-magnetic-moment-estimation calculation. Our calculation yields an estimated value of $|D_n| < 2 \times 10^{-26}$ e cm. This value is below the present experimental limit of 10^{-23} e cm. (auth)

21487 THE ISOSPIN AND ISOSPIN-SPIN POLARIZATIONS OF INTERACTING HADRONS. Ion, D.B.; Mihul, A.C. (Joint Institute for Nuclear Research, Dubna, Moscow, P. O. Box 79, U.S.S.R.). Ann. Phys. (N.Y.) 93: No. 1, 41-54 (5 Sept 1975).

In this paper we introduce two new dynamical variables: the isospin polarization and isospin-spin polarization of a hadron in the final state of a given reaction. As an application, the nucleon isospin polarization in pion-nucleon scattering is studied. The numerical results for nucleon isopolarization, determined from $\pi - P$ elastic and charge exchange reactions, are discussed. (auth)

21488 THE NUCLEON ISOSPIN-POLARIZATION AND ISOSPIN BOUNDS IN PION–NUCLEON SCATTERING. Ion, D.B.; Mihul, A.C. (Joint Institute for Nuclear Research, Dubna, Moscow, P. O. Box 79, U.S.S.R.). Ann. Phys. (N.Y.) 93: No. 1, 55-67 (5 Sept 1975).

The nucleon isospin-polarization parameter and its isospin bounds are determined from the experimental data of $\pi^- P$ elastic and charge exchange reactions. The saturation of the isospin bounds is explained in terms of the resonance poles and zeros of the isospin exchange amplitudes in the s, t, and u-channels. (auth)

21489 DETERMINATION OF THE PION-NUCLEON COUPLING CONSTANT. Hite, G.E. (Universität Kaiserslautern, Kaiserslautern, West Germany); Jacob, R.J.; Moir, D.C. Phys. Rev. D 12: No. 9, 2677-2683 (1 Nov 1975).

A method for determining the pion-nucleon coupling constant f^2 by the application of an interior dispersion relation to the $B^{(+)}$ πN scattering amplitude is presented and its advantages over other dispersion relation techniques are discussed. The method is used to calculate f^2 for two sets of phase shifts: CERN 71 of Almehed and Lovelace and a modified version of the Carter, Bugg, and Carter solution, to obtain $f^2 = (81.5 \pm 1.5) \times 10^{-3}$ and $f^2 = (79.5 \pm 1.0) \times 10^{-3}$, respectively. (auth)

21490 PHENOMENOLOGICAL ANALYSIS OF A FIXED-SPHERE BAG MODEL. Donoghue, J.F.; Golowich, E.; Holstein, B.R. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. D 12: No. 9, 2875-2885 (1 Nov 1975).

We perform a phenomenological analysis of baryon matrix elements in a fixed-sphere MIT bag model. The model consists of massive, noninteracting quarks which carry the usual SU(3) quantum numbers as well as an SU(3) of color. Two-quark matrix elements investigated include those of the σ operator and axial-vector and vector currents and the magnetic moment, charge radius, and dipole moments of the electromagnetic current. Among our results are the masses 44 MeV for nonstrange quarks and 298 MeV for strange quarks. The model is successful in predicting static properties of the lowest-mass baryons, but has a problem in describing the radiative decay of the nucleon resonance, $N^*_{13}(1520)$. Four-quark matrix elements, parity-violating nonleptonic decay amplitudes of the $\frac{1}{2}^+$ baryons, are investigated and are found to be poorly described by the model. (auth)

21491 COVARIANT HARMONIC OSCILLATORS AND THE AXIAL-VECTOR COUPLING CONSTANT. Ruiz, M.J. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 12: No. 9, 2922-2924 (1 Nov 1975).

The SU(6) value for the axial-vector coupling constant of the nucleon, which is 5/3, is modified by considering the relativistic motion of the quarks inside the hadron. The covariant harmonic-oscillator formalism of Kim and Noz is used to describe the internal quark motion. An excellent numerical result is obtained with reasonable choices for spring constant and quark mass. (auth)

21492 ADDENDUM TO "FINITE-NUCLEAR-SIZE EFFECTS IN K^-d REACTIONS". Chattarji, D.; Talukdar, B.; Sarkar, S.B. (Department of Physics, Visva-Bharati University, Santiniketan, West Bengal, India). Phys. Rev. D 12: No. 9, 2928-2928 (1 Nov 1975).

We discuss the dependence of transition amplitudes for K^-d reactions on the shape of the complex potential and present results for a Woods-Saxon well. (auth)

21493 COMMENT ON THE PHASES OF INELASTIC PARTIAL WAVES AND THEIR COMPARISON WITH THE QUARK MODEL, THE CURRENT TO CONSTITUENT QUARK TRANSFORMATION, SU(6)$_w$, AND VECTOR DOMINANCE. Söding, P. (Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany). Phys. Rev. D 12: No. 11, 3762-3764 (1 Dec 1975).

It is shown that the phases of inelastic πN partial-wave amplitudes can be absolutely determined, using results from photoproduction. The signs obtained for the resonant amplitudes confirm the agreement with the relativistic quark model, the Melosh transformation, the broken SU(6)$_w$ scheme, and with vector dominance in the comparison with photoproduction. (auth)

21494 STRONGLY-CORRELATED-RESONANCES MODEL: EXISTENCE THEOREM AND SOLUTION. Hoff, G.T. (Physics Department, University of Illinois at Chicago Circle, Chicago, Illinois 60680). Phys. Rev. D 12: No. 9, 2815-2820 (1 Nov 1975).

The problem of the existence of solutions to the equations for the differential cross section and polarization in the strongly-correlated-resonances model with simple assumptions about the background amplitudes (ideal scrm) is examined. It is found that besides the fulfillment of qualitative predictions, an equation of constraint at each angle must be satisfied by the six quantities which characterize the data between two consecutive junctions (two amplitudes, two initial phases, and two heights) in order for a solution to exist. As an application, the equation of constraint is tested with $\pi^+ p$ elastic data in the backward hemisphere 0.82 and 2.08 GeV/c (where the predictions of the ideal

model are fulfilled to a good degree of approximation). It is found to be consistent with the data. This quantitative test supplements previous qualitative ones, and could be also applied to the pure-isospin processes $\pi^- p \to \Lambda K^0$, $\pi^+ p \to \Sigma^+ K^+$, $\pi^- p \to \eta n$, and $K^- p \to \Lambda \pi^0$. Expressions for the background and resonance amplitudes in terms of the relevant experimental quantities in the ideal scrm are also given. These could be used as a first approximation to a more exact solution to the data. (auth)

21495 CONSEQUENCES OF NON-LINEARITY IN A UNIFIED THEORY OF FUNDAMENTAL INTERACTIONS. Kursunoglu, B. (Univ. of Miami, Coral Gables). pp 131-234 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

The equations of motion are derived and the results lead to mass relations for the four massive fundamental particles p, e, nu/sub e/, nu/sub mu/ and their anti-particles as half the difference of the "bare gravitational mass" m[approximately root(Dirac constant c/2G)] and their finite self-energies. Based on the extremum value properties of the vacuum magnetic field (generated by g_0) it is conjectured that the p-e and nu/sub mu/-nu/sub e/ mass ratios are equal. All elementary particles can be constructed as sub-nuclear bound or resonance states of the fundamental particles p, e, nu/sub e/, nu/sub mu/ and anti p, e^+, anti nu/sub e/, anti nu/sub mu/. It is further shown that the mass and charge appearing in the Nordstroem solution of general relativity correspond, for an elementary particle, to the bare gravitational mass and the observed electric charge and therefore they do not refer to either the bare or observed particles. (JFP)

21496 EXPANDED MODEL FOR LOW ENERGY MESON-BARYON SCATTERING. Bedard, R. R. St. Louis; St. Louis Univ. (1974). 99p. University Microfilms Order No. 75-26,226.

Thesis (Ph. D.).

This research is an investigation of low energy meson-baryon scattering using an effective Lagrangian formulation. The effective Lagrangian contains three and four point functions. The three point functions give the OPE contribution to the scattering and will represent the long range forces. The four point functions will give the short range contribution. These four point functions will contain four parameters that are low order polynomials in s, t, and u. These parameters are subject to crossing relations arising from the group theory and because of these the following forms for the four parameters are: alpha equals $\text{alpha}_0 + \text{alpha}_1(s-u)^2 + \text{alpha}_2 t + \text{alpha}_3 t^2$, beta equals $\text{beta}_0 + \text{beta}_1(s-u)^2 + \text{beta}_2 t + \text{beta}_3 t^2$, gamma equals $\text{gamma}_0 + \text{gamma}_1(s-u)^2 + \text{beta}_2 t + \text{gamma}_3 t^2$, and beta tilde equals $\text{beta tilde}_1(s-u) + \text{beta tilde}_2 t(s-u)$. Fourteen constants are determined to give the form to the alpha, beta, beta tilde, and gamma that will be used to project the partial wave scattering amplitudes. The Lagrangian is invariant under M(12) or U(6,6). Then, the symmetry is broken by introducing physical masses. The meson fields transform as the 35 dimensional representation of SU(6) while the baryons transform as the 56 dimensional representation. The model is applied to pi/sup +-/p yields pi/sup +-/p and KN yields KN scattering up to 300 MeV/c. The model does predict the N^*_{33} resonance near its actual energy. (Diss. Abstr. Int., B)

21497 CHARM-CHANGING WEAK NEUTRAL CURRENTS. Koide, Y. (Shizuoka Women's Univ., Japan). Lett. Nuovo Cim.; 15: No. 3, 80-82(17 Jan 1976).

The possibility of observation of charm-changing neutral currents which was previously pointed out from the standpoints of the lepton-urbaryon correspondence and of a composite model, respectively, is investigated. First the charmed baryon production by high energy neutrino beams and then the decays of the vector meson D* into lepton pairs are discussed. (JFP)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 21008, 21591, 21749, and 21778.

21498 (ANL/HEP-CP-75-58, pp 309-317) DUALITY AND RESONANCE BACKGROUND. Dickey, J. O. (Rutgers—The State Univ., New Brunswick, NJ). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

Only SU(3) and duality diagrams are used to predict background for any meson-octet baryon scattering in terms of two isostates. (JFP)

21499 (ANL/HEP-CP-75-58, pp 383-406) BARYONIC SPECTROSCOPY AND ITS IMMEDIATE FUTURE. Dalitz, R. H. (Oxford Univ.). 1975.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In new directions in hadron spectroscopy. (Argonne National Lab., Ill. (USA)).

The quark model is reviewed briefly for baryons and the various versions of SU(6) symmetry which were proposed and used in connection with baryon spectroscopy are reviewed. A series of basic questions are reviewed which experimental work in this field should aim to settle, as a minimal program. One also heralds the beginning of a new baryon spectroscopy associated with psi physics. (auth)

21500 (JINR-D1-5969, pp 649-666) ELECTROMAGNETIC CORRECTIONS TO SCATTERING OF FAST CHARGED PARTICLES ON NUCLEI. Kondratyuk, L. A.; Kopeliovich, V. B. (Inst. for Theoretical and Experimental Physics, Moscow). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The electromagnetic corrections to the amplitude of pion-nucleus scattering at high energy and small momentum transfer are considered. The uncertainty of electromagnetic corrections to the πN amplitude, the Glauber formula for pion-nucleus scattering with account of the Coulomb interaction, conditions of validity and errors of generalized Glauber formula, the difference of π^- and π^+ total cross sections on nuclei with zero isospin, and $\pi^\pm$ d scattering are discussed. (JFP)

21501 SIXTEEN RELATIONS BETWEEN OBSERVABLES IN NUCLEON-NUCLEON SCATTERING. Bourrely, C.; Soffer, J. (Centre de Physique Théorique, Centre National de la Recherche Scientifique, Marseille, France). Phys. Rev. D 12: No. 9, 2932-2934 (1 Nov 1975).

Assuming all the usual invariance properties (parity, time-reversal, identical particles) in *p-p* elastic scattering, twenty-five independent observables are available if one can detect the spin of each particle in all possible configurations. Since the scattering matrix depends upon nine real functions of s and t, up to an over-all phase, one expects sixteen independent relations between the observables. To derive these relations, we give a simple method which is valid for any scattering process. (auth)

21502 REGGE MODEL FOR THE REACTION $pp \to \pi^+ d$. Shtokhamer, R.; Lichtenberg, D.B.; Heinz, R.M. (Physics Department, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 12: No. 9, 2666-2669 (1 Nov 1975).

A calculation is made of the differential cross section and proton polarization for the reaction $pp \to \pi^+ d$ using a Regge-pole model with the exchange of the N_α and N_γ baryon trajectories. The adjustable parameters of the model are varied to obtain a best fit to the cross-section data at incident momenta above 7 GeV/c. The polarization is predicted to have the characteristic feature of vanishing at $t = -0.2$ and $t = -1.2$ $(\text{GeV}/c)^2$. (auth)

21503 PION INCLUSIVE MOMENTUM DISTRIBUTION AT 90° IN A HYDRODYNAMICAL MODEL. Chiu, C.B; Wang, K. (Center for Particle Theory, Department of Physics, University of Texas, Austin, Texas 78712). Phys. Rev. D 12: No. 9, 2725-2732 (1 Nov 1975).

We show that pion inclusive momentum distributions in *pp* collisions at 90° up to Fermilab and CERN-ISR energies can be accounted for by a hydrodynamical model which has frame-independence symmetry and incorporates the evaporation phenomena. Within our solution, during its space-time development, the matter system only possesses a local thermal equilibrium but not a global equilibrium. The proper-time interval needed to achieve this equilibrium comes out to be comparable (with $c = 1$) to the longitudinal dimension estimated previously based on considerations of quantum statistical fluctuation. (auth)

21504 PRODUCTION AND LEPTONIC DECAY MODES OF CHARMED MESONS. Barnett, R.M. (Lyman Laboratory of Phyiscs, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 12: No. 11, 3441-3443 (1 Dec 1975).

Charmed meson production in hadronic collisions is estimated in a general peripheral model. The shape of the spectra of leptons from charmed-meson decay modes is shown, and bounds are given on branching ratios to those decay modes. A possible source of leptons in hadronic collisions is suggested. (auth)

21505 ABSORPTIVE CORRECTIONS TO THE PION-EXCHANGE DECK AMPLITUDE. Berger, E.L.; Irving, A.C. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 12: No. 11, 3444-3447 (1 Dec 1975).

Consequences of absorbing the pion-exchange amplitude in Deck

models are investigated. We make quantitative estimates of the largest corrections to be reasonably expected from an approach to absorption which has been successful in two-body processes. We conclude that the major features of the low-mass enhancement (e.g., spin-parity content, mass, and angular distributions) obtained from the model are not altered by absorption. (auth)

21506 ABSORPTIVE EFFECTS IN EXCLUSIVE DIFFRACTION DISSOCIATION. Berger, E.L.; Pirilä, P. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 12: No. 11, 3448-3468 (1 Dec 1975).

We report a detailed investigation of absorptive corrections in Good-Walker and Deck-type models for production of three-body final states in diffraction dissociation processes. Beginning with an input elastic diffractive amplitude which is central in impact parameter, the model generates naturally a peripheral structure for inelastic diffraction. For $pp \to (n\pi^+)\ p$ and $np \to (p\pi^-)\ p$, at small excitation mass, absorptive effects create significant dip structure in the production momentum transfer distribution $d\sigma/dtdM$ near $t \simeq -0.3$ (GeV/c)^2, in agreement with data from Fermilab and the CERN-ISR. Similar behavior is predicted for $\pi p \to A_1 p$ and $Kp \to Qp$, but at larger $|t|$. Distributions in other kinematic variables are much less affected by absorption. We provide a decomposition of the total $d\sigma/dtdM$ into partial cross sections for the various angular momentum and helicity states which comprise the low-mass diffractive enhancement. The s-wave amplitude is dominant in both absorbed and unabsorbed models. A pronounced mass-slope correlation is present both in the total $d\sigma/dtdM$ and in the s-wave part alone. (auth)

21507 s-WAVE PRODUCTION OF PIONS IN $p + p \to \pi^+ + d$. Spuller, J.; Measday, D.F. (Department of Physics, University of British Columbia, Vancouver, B.C., Canada, V6T 1W5). Phys. Rev. D 12: No. 11, 3550-3555 (1 Dec 1975).

The data for the total cross-section for $p + p \to \pi^+ + d$ are reanalyzed to obtain the component for s-wave pion production near threshold. This comprehensive analysis yields a value which is compatible with other low-energy pion-nucleon reactions. (auth)

21508 PRODUCTION OF BARYONS WITH LARGE TRANSVERSE MOMENTUM. Landshoff, P.V.; Polkinghorne, J.C. (Department of Applied Mathematics and Theoretical Physics, Cambridge University, Cambridge, England); Scott, D.M. Phys. Rev. D 12: No. 11, 3738-3746 (1 Dec 1975).

The multiple scattering of constituent quarks provides a natural mechanism for fairly copious production of large-transverse-momentum baryons in nucleon-nucleon collisions. The predicted scaling law agrees well with available data, and the mechanism provides a qualitative explanation of nuclear-target effects. In comparison with previous parton models, correlations are predicted to be qualitatively different, and large-p_T baryon production by meson beams is relatively suppressed. (auth)

21509 IMPLICATIONS OF THE ENERGY DEPENDENCE OF A NEW NUCLEON-NUCLEON POTENTIAL. Lomon, E.L. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 12: No. 11, 3758-3759 (1 Dec 1975).

The energy dependence of the core of a new potential formulated by Lacombe, Loiseau, Richard, and Vinh Mau is shown to be replaceable by an energy-independent boundary condition. Furthermore, the radius at which the boundary condition is applied is very close to that of the Feshbach-Lomon interaction, 0.7 F. Outside the core the new potential has a strong basis in theory. It is recommended that further exploration be done with theoretical potentials outside of a boundary-condition-model core. (auth)

21510 AMBIGUITIES IN THE DERIVATION OF PHASE PARAMETERS FROM A PERTURBATIVE MODEL FOR ELASTIC NUCLEON-NUCLEON SCATTERING. Bock, C.W. (Department of Physics, Philadelphia College of Textiles and Science, Philadelphia, Pennsylvania 19144); Haracz, R.D. Phys. Rev. D 12: No. 11, 3765-3769 (1 Dec 1975).

Three methods for defining nucleon-nucleon phase parameters from approximations of the scattering operator are described. They are based on the Heitler and exponential forms for the scattering operator and on a third method that forces unitarity on the scattering operator by putting it into polar form. The methods are applied to a model due to Bock and Haracz which includes the one- and two-pion-exchange processes with the one-vector-meson exchanges as defined in relativistic quantum field perturbation theory. Significant differences in the larger F- and D-state phase shifts are noted in the model. (auth)

21511 THREE-BODY CALCULATION OF PION-DEUTERON ELASTIC SCATTERING. Moum, G. K. Columbia, MO; Univ. of Missouri (1974). 80p. University Microfilms Order No. 75-20,143.

Thesis (Ph. D.).

The mathematical structure of the pion-deuteron elastic scattering system, considered as a three-body problem, is investigated. On-energy-shell two-body single-scattering interactions are used. Calculational techniques are presented which were developed for the evaluation of the many discrete and continuous summations necessary for the proper treatment of the two-body interactions. Differential scattering cross sections are calculated for pion laboratory frame kinetic energies of 61, 85, 142, 183, and 256 MeV. A comparison is made with recent work on this system. (Diss. Abstr. Int., B)

21512 USE OF THE SIGMA-MODEL FOR DESCRIBING NEUTRON–PROTON CHARGE EXCHANGE SCATTERING. Lendel, A. I.; Lend'el, V. I.; Salak, M. A. (Inst. of Theoretical Physics, Uzhgorod, USSR). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 11, 1832-1837(Nov 1975). (In Russian).

On the basis of the σ-model type interaction, a good description is obtained for differential cross sections of the neutron-proton charge exchange scattering process in the forward cone within the energy range of 0 to 30 GeV. (auth)

21513 EVALUATION OF PROTON–PROTON ELASTIC SCATTERING WITH QUARK HARD CORES USING GLAUBER AND MONTE CARLO METHODS. Klenk, K. F. (Lehigh Univ., Bethlehem, PA); Kanofsky, A. S. J. Comput. Phys.; 19: No. 4, 353-375(Dec 1975).

It is shown how Monte Carlo methods can be used to evaluate multidimensional integrals that occur in Glauber scattering theory. A detailed discussion of the various Monte Carlo methods is given. The methods are used to obtain the proton-proton elastic scattering differential cross section, where the proton is composed of three quarks with hard cores. It is found that including a quark hard core has no effect on the differential cross section for a fixed rms quark distance. (auth)

21514 CHARGE TRANSFER IN pp COLLISIONS ACCORDING TO A MIXED TWO-COMPONENT MODEL. Gupta, V.; Malhotra, P. K.; Narayan, D. S. (Tata Inst. of Fundamental Research, Bombay). Pramana; 5: No. 5, 249-259(Nov 1975).

The charge transfer from one hemisphere to the other, observed in pp-collisions is explained on the basis of a "mixed two component" model, which has been proposed previously to account for the multiplicity distribution of charged particles. Results of the calculations, based on the model, for various measurable quantities relating to charge transfer are compared with the available experimental data. (3 figures, 1 table) (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 21732.

21515 (DESY-75/50) ALL UNITARY RAY REPRESENTATIONS OF THE CONFORMAL GROUP SU(2,2) WITH POSITIVE ENERGY. Mack, L. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1975. 51p. Dep. NTIS (US Sales Only) $4.50.

All those unitary irreducible representations of the ∞-sheeted covering group G of the conformal group $SU(2,2)/Z_4$ which have positive energy $P^0 \geq 0$ are found. They are all finite component field representations and are labelled by dimension d and a finite dimensional irreducible representation (j_1,j_2) of the Lorentz group SL(2C). They all decompose into a finite number of unitary irreducible representations of the Poincaré subgroup with dilations. (auth)

21516 (DESY-75/51) ANALYTIC REPRESENTATIONS OF SIMPLE LIE GROUPS AND THEIR CONTINUATION TO CONTRACTIVE REPRESENTATIONS OF HOLOMORPHIC LIE SEMIGROUPS. Luescher, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1975. 43p. Dep. NTIS (US Sales Only) $4.00.

A unitary representation of a Lie group G is called analytic, if one of the infinitesimal generators of G is represented by $\sqrt{-1}$ times a positive selfadjoint operator. A simple Lie group G with Lie algebra g has analytic representations if any maximal compactly embedded subalgebra k of g has nonzero center. Irreducible analytic representations have a highest weight with respect to a compact Cartan-subalgebra of g. In case G has analytic representations it is also a boundary group of a holomorphic Lie semigroup S_G whose complex dimension equals the (real) dimension of G. These semigroups are investigated in some detail. It is finally proven that an analytic representation of G can always be analytically continued to a holomorphic, contractive representation of S_G. (auth)

21517 ONE-LOOP DIVERGENCES OF THE NONLINEAR CHIRAL THEORY. Tătaru, L. (Department of Physics, University of Craiova, Craiova, Roumania). Phys. Rev. D 12: No. 10, 3351-3352 (15 Nov 1975).

An application of dimensional renormalization to chiral-invariant theories is presented. The naive Feynman rules may be used in this framework without introducing any noninvariant corrections to the on-mass-shell S matrix in the one-loop approximation. Moreover, the soft-pion theorem is fulfilled in all orders of perturbation theory. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 21381, 21382, 21409, 21412–21416, and 21419.

21518 SU(3) CONTEXT OF A NEW WEAK CURRENT. Pappas, R.; Wellner, M. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 12: No. 10, 3341-3342 (15 Nov 1975).

A recently proposed weak isosinglet current is shown to bear a close relation to the group SU(3). (auth)

Applications (Strong)

Refer also to abstracts 21428, 21466, and 21486.

21519 (JINR-D1-5969, pp 667-702) ALGEBRAIC REALIZATION OF CHIRAL SYMMETRY. Amplitudes and Hadron Mass Spectra. Noga, M. (Komensky Univ., Bratislava). 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

Making use of generally accepted assumptions about the equal-time commutator algebra of axial charges and axial divergences, the spin and helicity dependence of Weinberg's algebraic relations is entirely determined for pions in arbitrary partial waves. It is shown that the algebraic structure of axial vector coupling matrices is uniquely given by the Lie algebra of the group SO(4, 3) and so hadron states must be assigned to unitary representations of this group. Furthermore it is proved that mass spectrum operator is given as a sum of a scalar and a component of a 35-dimensional totally antisymmetric irreducible tensor of the group SO(4, 3). The general form of the mass spectrum is exhibited as a linear combination of the Clebsch-Gordan coefficients of the group SO(4, 3). Application to hadron states of fixed intrinsic quantum numbers leads to the conclusion that mass-squared values of hadrons must be a linear function of spins. This result is a unique and exact consequence of the structure of Weinberg's algebraic relations. (auth)

21520 SU(4)-SYMMETRIC STRONG-COUPLING THEORY. McGlinn, W.D. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. D 12: No. 10, 3246-3250 (15 Nov 1975).

SU(4) -symmetric strong-coupling theory is investigated using the method of induced representations. Isobar content is discussed for various choices of the little group. For a particularly interesting case, the unitarity condition is solved. (auth)

21521 NUCLEON REPRESENTATION OF THE ALGEBRA OF REGGE RESIDUES AND CHIRAL SYMMETRY. Mohan, L.R.R. (Department of Physics, University of Delhi, Delhi 110007, India). Phys. Rev. D 12: No. 9, 2886-2892 (1 Nov 1975).

A nucleon saturation scheme for the algebra of Regge residues and chiral symmetry is studied. A representation of this extended algebra SU(2) $\times$ SU(2) $\times$ O(5) includes the nucleon N (940), the Δ (1236), and two other nucleon resonances. The masses for the resonances, the low-energy pionic coupling, and the Regge coupling of the ρ, f, π, and A_1 trajectories to the particles present in the scheme are predicted and the results are compared with experimental numbers. (auth)

21522 SU(4) σ MODEL. Schechter, J. (Physics Department, Syracuse University, Syracuse, New York 132i0); Singer, M. Phys. Rev. D 12: No. 9, 2781-2790 (1 Nov 1975).

The mass spectrum of pseudoscalar and scalar mesons is discussed in a general linear SU(4) σ model. We study the way in which the spectrum is influenced by the symmetry of the vacuum and by terms which are the analogs of quark mass terms and quark interaction terms. It is found that a paracharmonium-like state can be naturally accommodated if the charmed "quark mass" is much larger than the others. Other possibilities are also investigated. (auth)

21523 SHORT-DISTANCE SYMMETRIES, THE AXIAL ANOMALY, AND THE CONFORMAL GROUP. Bég, M.; Shei, S. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 12: No. 10, 3092-3097 (15 Nov 1975).

We discuss symmetry at small distances, focusing in particular on the implementation of the conformal group. In the framework of a theory which generates strong interactions from a non-Abelian gauge group, we show that the existence of the axial anomaly—which determines the amplitude for $\pi^0 \to 2\gamma$—as well as the nonrenormalization theorem for this anomaly are consequences of conformal symmetry. (auth)

21524 SOLVING THE INVERSE PROBLEM OF QUANTUM SCATTERING THEORY. Levitan, B. M. (Moscow State Univ.). Mat. Zametki; 17: No. 4, 611-624(Apr 1975). (In Russian).

An investigation is made of the inverse problem with respect to scattering phase for the boundary value problem $-y'' + q(x)\,y = k^2 y$ $(0 \le x < \infty)$, (1), $y'(0) = hy(0)$. (2) It is proved that for every function $\delta(k)$ satisfying the conditions of the Levinson theorem there is a problem (1)-(2) with $h \neq \infty$ and another problem (1)-(2) with $h = \infty$ (i.e., with boundary condition $y(0) = 0$). In deriving boundary conditions (2), more direct use is made of the conditions of solvability of the Riemann-Hilbert problem for the half-plane than was previously done. (JPRS)

21525 HADRONIC SYMMETRY BREAKING. Kapila, V. M. Amherst, MA; Univ. of Massachusetts (1975). 162p. University Microfilms Order No. 75-27,540.

Thesis (Ph. D.).

The scalar dominance hypothesis, incorporating epsilon-epsilon' mixing, is applied to a large class of elastic, single particle matrix elements of the energy momentum trace operator. Both theoretical and phenomenological aspects of broken SU(3) coupling constant sum rules are considered. Assumptions underlying the conventional derivations of these sum rules are discussed. A phenomenological analysis of tensor meson decays is carried out. Four coupling constant sum rules are analyzed, and the ambiguity problem in defining empirical coupling constants is studied. Also considered are the phenomenological and theoretical aspects of single particle contributions to sum rules derived from commutation relations. A derivation of sum rules arising from an equal time axial-charge algebra evaluated between arbitrary single particle states is given. An analogous derivation of sum rules associated with the sigma operator is shown to be invalid. The difficulties associated with the Gell-mann, Oakes and Renner model of the hadronic symmetry breaking are discussed, and a modified model due to Gell-mann and Wilson is studied in detail. The Wigner-Eckart theorem and a modified low energy theorem for pions is employed to determine parameters of interest of the Gell-mann-Wilson model. (Diss. Abstr. Int., B)

Scattering Theory

Refer also to abstracts 21356 and 21895.

21526 (JINR-D1-5969, pp 539-557) EIKONALIZATION OF SCATTERING AMPLITUDES IN SOME FIELD THEORY MODELS AT HIGH ENERGIES. Barbashov, B. M.; Nesterenko, V. V. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21527 (JINR-D1-5969, pp 579-587) CONSTRUCTION OF DUAL AMPLITUDES BY MEANS OF A FINITE NUMBER OF OSCILLATOR-TYPE OPERATORS. Kvinikhidze, A. N.; Markovski, B. L.; Popov, Kh. D.; Stoyanov, D. Ts.; Tavkhelidze, A. N. 1971.

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21528 (ORO-4856-44) HEURISTIC METHOD FOR DETERMINING OUTGOING WAVES IN MANY-BODY WAVE FUNCTIONS. Redish, E. F.; Tandy, P. C.; L'Huillier, M. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Dec 1975. 11p. Dep. NTIS $3.50.

A new and simple method is proposed for determining the kinds of outgoing waves present in a given many-body wave function. Whether any particular wave function contains "hidden" rearrangement components can be determined. 1 figure (auth)

21529 DIRECT-CHANNEL TESTS OF THE STRONG-COUPLING POMERON. Cardy, J.L. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 12: No. 10, 3346-3350 (15 Nov 1975).

We discuss how the strong-coupling renormalization-group solution of Reggeon field theory satisfies some of the simplest constraints of direct-

channel unitarity, including those which lead to the decoupling theorems for the simple Pomeron pole. (auth)

21530 SCATTERING IN PARABOLIC COORDINATES AND A NEW REPRESENTATION FOR THE SCATTERING AMPLITUDE. Azzarelli, T. (Xonics Inc., Van Nuys, California 91406); Collas, P. Phys. Rev. D 12: No. 10, 3237-3245 (15 Nov 1975).

We derive and investigate an exact integral representation of the scattering amplitude that results from the description of scattering in parabolic coordinates. The spectral function $a(s,\nu)$ of this representation turns out be an entire function of order 1 in the ν variable provided that the partial-wave amplitude $A_l \sim l^{-1/2}C^{-l\xi}$, $\xi > 0$ for l large. We also briefly discuss the counterpart of the partial-wave series. (auth)

21531 ON ANALYTIC NONLOCAL POTENTIALS. IV. A CLOSED CONTOUR DISPERSION RELATION. Yao, T.H. (Mathematics Department, Bedford College, Regent's Park, London NW1, England). J. Math. Phys. (N.Y.) 17: No. 1, 13-16 (Jan 1976).

We give a class of analytic nonlocal potentials which give rise to a closed contour s-wave dispersion relation for sufficiently small coupling constant. (auth)

21532 INCLUSIVE CROSS SECTIONS AND ANGULAR DISTRIBUTIONS IN REGGEON FIELD THEORY. Abarbanel, H.D.I.; Bartels, J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Bronzan, J.B.; Sidhu, D. Phys. Rev. D 12: No. 9, 2798-2814 (1 Nov 1975).

We use the Reggeon field-theory rules for inculsive reactions to study those processes in the triple-Regge region. We first show that at asymptotic energies the dominant Reggeon graphs have a single Pomeron connected to external fast particles. We construct the sum of these dominant graphs by obtaining the infrared forms of the Pomeron propagator and triple-Pomeron vertex. This is done by an expanded set of renormalization-group equations which allow one to determine the separate dependencies on all momenta and energies. As a by-product we obtain the momentum-transfer dependence of $d\sigma/dt$ in $2 \to 2$ processes. The inclusive cross section is discussed in detail as to its dependence on momentum transfer and missing mass, and we verify that there is no violation of s-channel unitarity when Pomerons interact among themselves. We also estimate the energy at which our asymptotic forms start to become valid. (auth)

21533 EXTENSIONS OF THE DERIVATIVE DISPERSION RELATIONS FOR AMPLITUDE ANALYSES. Sukhatme, U.; Kane, G.L. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48104); Blankenbecler, R.; Davier, M. Phys. Rev. D 12: No. 11, 3431-3440 (1 Dec 1975).

It is shown that analyticity properties of scattering amplitudes as expressed by the derivative analyticity relations can be combined with measured cross-section and polarization data to extract the full scattering amplitudes in a simple and practical way. The method should be particularly useful in problems involving a coupled amplitude analysis. The measurement of a complete set of spin parameters, or a phase-shift analysis at only one energy, is sufficient to eliminate ambiguities in the extraction at all other energies. Our procedure is illustrated by considering both simple mathematical examples and real data. (auth)

21534 STRONG-COUPLING LIMIT OF REGGE TRAJECTORIES IN THE phi^3 LADDER MODEL AND A THREE PARTICLE K MATRIX MODEL. Miller, R. L. Urbana, IL; Univ. of Illinois (1974). 151p. University Microfilms Order No. 75-11,796.

Thesis (Ph. D.).

Two quite different problems in high energy physics are investigated. In the first one extends to t not equal to 0 a technique, employing the Bethe–Salpeter equation, developed by Chang and Rosner to study the strong-coupling limits of ladder graph models. One can calculate the first nontrivial t-dependent term in the trajectory function alpha(t) for phi^3 theory. The behavior of alpha(t) depends upon whether the exchanged particle is massless. One also indicates how daughter trajectories may be calculated. For the second problem a model is proposed for a three-particle K matrix in a system where no two particle yields three particle transitions are allowed. The resulting unitary three yields three scattering amplitude is shown to have the correct logarithmic branch point at the three-particle threshold. The singularity structure of the amplitude is investigated, and resonance (two body)–particle thresholds are present. A connection is made between resonance-particle scattering and stable two-body scattering, even in the presence of overlapping resonances. These unitary results are then applied to a two particle yields four particle production process, and some numerical results for the reaction pi$^-$p yields 3 pi p are presented. (Diss. Abstr. Int., B)

21535 STATES IN QUANTUM MECHANICS AND A PROBLEM OF OPERATOR THEORY. Moroz, B. Z. Zap. Nauchn. Semin., Leningr. Otd., Mat. Inst., Akad. Nauk SSSR; No. 39, 189-190 (1974). (In Russian).

The following problem is stated which has a quantum mechanical origin: the self-adjoint operators $A_1, \ldots, A_n$, $1 \le n \le \infty$ are given in the Hilbert space X; P^{Δ} is the spectral dimension of the operator A; is it possible, knowing the norms $|| P^{\Delta_k}(E) \times ||$ for all k and for all Borel sets E, to regenerate the vector x? More precisely, does it follow from the equalities $||P^{\Delta_k}(E) \times || = ||P^{\Delta_k}(E) y ||$, $\forall k \in E$, that $x = \lambda y$, where $|\lambda| = 1$? It is proved that for any orthogonal base $\{f_k^1\}_{k\ge1}$, it is possible to construct the orthobasis $\{f_k^2\}_{k\ge1}$ and $\{f_k^3\}_{k\ge1}$ in x such that $|(x, f_k^2)| = |(y, f_k^3)|$, $\forall \forall k \to x = \lambda y$, $|\lambda| = 1$. The hypothesis is stated regarding the correctness of such statements for any three bases located in the "usual position" (that is, such that the corresponding families of orthoprojectors will not have common invariant subspaces). It is noted that the pairs of operators $f(x) \to xf(x)$ and $f(x) \to (d/dx)f(x)$ $L_2(R)$ is not sufficient for "recognition" of the functions from $L_2(R)$ (this function f is not defined uniquely by the value of $|f|$ and $|\hat{f}|$). The question stated at the beginning of the abstract is especially of interest in the case of $X = L_2(R^n)$, $A_{2k} = e^{-|H|k^2}$, $A_{2k+1} = A_{2k}$ (the Fourier transformation), where $H_k = -\Delta + u_k$, u_k are the potentials which must be selected in the corresponding way.

21536 TWO-DIMENSIONAL SCATTERING AMPLITUDE EXPANSION IN MATRIX ELEMENTS OF THE de SITTER GROUP IRREDUCIBLE UNITARY REPRESENTATIONS. Kachurik, I. I.; Khimich, I. V. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 11, 1795-1804(Nov 1975). (In Russian).

Two-dimensional scattering amplitude expansion in matrix elements of the de Sitter group irreducible unitary representations is considered. The Pomeranchuk theorem is derived on the basis of the obtained expansion for the amplitude of the arbitrary binary process of scalar particles scattering without explicit utilization of analytical properties of the scattering amplitude. (auth)

21537 SINGULARITIES OF THE TRANSPORT SOLUTION AND OF ITS FIRST ORDER DERIVATIVES IN ABSENCE OF SCATTERING KERNEL. Van Binnebeek, J. J. (Univ., Brussels). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 434-453(1975).

The discontinuities of the flux and of its first partial derivatives are denumerated and classified in a pure transport problem with vacuum boundary conditions, when the cross section and/or the volume source functions or their partial derivatives suffer discontinuities along some boundaries and when these boundaries have no unique normal at some points. It shows that the flux function ceases to be smooth along pieces of the transport characteristic straight lines tangent to some of the discontinuity surface or passing through an edge of those boundaries. Those singularities are practically important because they generate a slow convergence in the numerical processes, as well as a failure of the usual proofs for the consistency of numerical algorithms. (auth)

21538 ENERGY MOMENTS OF SCATTERING PHASE SHIFT FOR PARTLY NONLOCAL MOMENTUM DEPENDENT INTERACTION. Warke, C. S. (Tata Inst. of Fundamental Research, Bombay). Pramana; 5: No. 5, 268-273(Nov 1975).

The phase shift sum rules recently derived by Puff are extended for a general partly non-local momentum dependent potential. In achieving this, one must use Fredholm determinant of the outgoing solution of the Schrodinger equation instead of the Jost function as was done by Puff. The constants appearing in the moment relations are explicitly defined in terms of the momentum representation of the interaction. (auth)

PHYSICS (LOW-TEMPERATURE)

Superconductivity

Refer also to abstracts 20620, 20656, 20733, 20755, 20765–20768, 20779, 20780, 20782, 20784, 20785, 20787, 20789, 20792, 20801, 20802, 20804, 20805, 20808, 20810, 20814, 20828, 20848, and 20852.

21539 ULTRASONIC ATTENUATION IN SUPERCONDUCTORS. Tittmann, B. R. (Rockwell International, Thousand Oaks, CA). pp 52-67 of Internal Friction and Ultrasonic Attenuation in Crystalline Solids. Vol. I. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973). See CONF-730844-P1.

The discovery, early development, and BCS theory of the ultrasonic attenuation in superconductors is reviewed. It is shown that the BCS formulation containing the concept of a superconducting energy gap leads to a satisfactory explanation of the temperature dependence of the attenuation for a wide range of superconductors. Emphasis is placed on recent measurements which exhibit drastic deviations from the simple behavior described by BCS. Experiments are reviewed on the amplitude dependence in attenuation associated with the motion of dislocations and on the influence of vortex lines on the magnetic field dependence of the attenuation in type-II superconductors. (38 references, 11 figs) (auth)

21540 SPATIAL VARIATIONS OF THE ORDER PARAMETER IN SUPERCONDUCTORS CONTAINING A MAGNETIC IMPURITY. Schlottmann, P. (Institut für Theoretische Physik, Freie Universität Berlin, 1 Berlin 33, Arnimallee 3, Germany). Phys. Rev. B 13: No. 1, 1-7 (1 Jan 1976).

The spatial variation of the superconductor order parameter in the presence of a classical spin has been analyzed by solving self-consistently the Gorkov equation for the one-particle Green's function. In the vicinity of the impurity the deviations from the bulk pair potential Δ is of the form $\Delta A\ (T)\ \sin^2 k_F r/(k_F r)^2$, where $A\ (T)$ is a temperature-dependent factor. At large distances from the impurity, $r \gg \xi_0$ (ξ_0 is the superconductor coherence length at zero temperature), $\Delta\ (r)$ varies like $1/r$ near the transition temperature, as is expected from the Ginzburg-Landau theory. At low temperatures the spatial dependence is oscillatory and decreases as $1/r^3$. (auth)

21541 PUSH-ROD AC SUSCEPTIBILITY APPARATUS. Hauser, J.J.; Antosh, C.M. (Bell Laboratories, Murray Hill, New Jersey 07974). Rev. Sci. Instrum. 47: No. 1, 156-157 (Jan 1976).

A push-rod ac susceptibility apparatus which permits the measurement of ultrathin films of superconductors and ferromagnets as a function of temperature and magnetic field is described. Films prepared at 77 K can be mounted under liquid nitrogen and measured without warmup. (auth)

21542 BAND STRUCTURE OF THE TCNQ–TTF SYSTEM. Ladik, J. (National Institutes of Health, Bethesda, MD). Int. J. Quant. Chem., Symp.; No. 9, 563-567(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

On the basis of already performed SCF all-valence electron crystal orbital calculations one can conclude that the conduction band of poly($TCNQ^-$) and the valence band of poly(TTF^+) will cross only when the interactions between the charged polyradical chains are taken into account in a proper way. The different main steps to obtain a realistic band structure of the rather complex TCNQ–TTF system (which could serve as a starting point for the interpretation of its unusual conduction properties) are briefly outlined. (auth)

21543 LARGE ELECTRON–PHONON INTERACTION BUT LOW-TEMPERATURE SUPERCONDUCTIVITY IN LaB_6. Arko, A. J. (Argonne National Lab., IL); Crabtree, G.; Ketterson, J. B. Int. J. Quant. Chem., Symp.; No. 9, 569-578(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Combined experimental and theoretical studies are reported of the Fermi surface, band structure, generalized magnetic susceptibility, electron–phonon enhancement factor lambda, and superconducting transition temperature T/sub c/ of LaB_6. Whereas the unusually large lambda values, ranging from 1.0 to 2.5, are expected to result in high T/sub c/ values, T/sub c/ is observed to be only 0.122°K. These results further emphasize the need for appropriate theoretical formulations for these systems. (auth)

21544 SUPERCONDUCTIVITY IN 1974. Matthias, B. T. (Univ. of California, San Diego, La Jolla). Int. J. Quant. Chem., Symp.; No. 9, 579-580(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A brief review is given of progress in superconductivity research during 1974, with emphasis on high temperature (22°K) superconducting compounds. 13 refs (GHT)

21545 SUPERCONDUCTIVITY AND STRUCTURAL INSTABILITY. Testardi, L. R. (Bell Telephone Labs., Murray Hill, NJ). Comments Solid State Phys.; 6: No. 5-6, 131-139(1975).

Reference is made to Batterman and Barrett who found that V_3Si, which is one of the A-15 structural class of high T_c superconductors, underwent a phase transition at about 20 K, just above its superconducting transition temperature (17 K). At the time this was regarded as a surprising result, but it is now regarded as very important in the field of high temperature superconductors, and is in fact used as a guide in searching for better superconductors. In this paper the following questions are discussed: what has caused this change in the approach to high T_c superconductivity?; what is the experimental evidence?; how well is it understood?; and what research advantages will accrue? Earlier and more recent work is discussed. (16 references) (UK)

21546 FLUX MOTION AND PINNING IN SUPERCONDUCTORS THROUGH FLUX FLOW NOISE MEASUREMENTS. Thompson, J. D. Cincinnati; Univ. of Cincinnati (1975). 192p. University Microfilms Order No. 75-25,930.

Thesis (Ph. D.).

The motion of fluxoids in type II superconducting foils has been studied by analyzing the time dependent voltage through measurements of its associated noise power spectrum. A noise power spectrum is characterized by three parameters: (1) its high frequency behavior, (2) its value in the limit of zero frequency, and (3) a so-called critical frequency. Information regarding the temporal behavior of flux motion is obtained primarily from the critical frequency and high frequency characteristic of the noise power spectrum; whereas, the spatial behavior of moving fluxoids determines the zero frequency value of the spectrum. Over 300 noise power spectra have been measured on foils of Pb 80 at. percent In 20 at. percent. Measurements have been performed as a function of the metallurgical condition of the foils, applied magnetic field value and direction, dc voltage level, and sample and voltage probe geometry. Data from this research indicate that flux pinning due to material inhomogeneities, such as grain boundaries, dislocations and surface irregularities, is fundamentally important in determining both the temporal and spatial behavior of flux motion in type II superconductors. In particular a new model of flux flow noise power spectra is proposed in which fluxoids are momentarily detained at pinning centers during their transit across the sample. Using this model much better agreement with the data is obtained on both the critical frequency and high frequency behavior of the spectra than with previous models. Analysis of the zero frequency limit of the noise power spectra enables information to be obtained regarding the number of fluxoids that move together as a unit. (Diss. Abstr. Int., B)

PHYSICS (NUCLEAR)

Refer also to abstract 20306.

21547 (AECL-5256) PHYSICS DIVISION PROGRESS REPORT, JULY 1 TO SEPTEMBER 30, 1975. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1975. 132p. (PR-P-107). Dep. NTIS (US Sales Only) $6.00. AECL $7.00.

Work in nuclear physics, accelerator and applied physics, and solid state physics is reported, along with the development of CdTe detectors. The Knight shift of the $29/2^+$ isomer of ^{213}Fr was measured in a Tl host. Second-order polarization corrections brought calculated g factors of the N = 126 nuclides into better agreement with experiment. The heavy-ion superconduction cyclotron development program was continued. Work of the mathematics and computation branch and accelerator operation during the quarter were summarized. Several pieces of work are listed separately by title. (RWR)

For titles of individual papers see: 20731, 21268, and 21269.

21548 (GEAP-14073-1) COOPERATIVE NUCLEAR DATA AND METHODS DEVELOPMENT. First Annual Progress Report for Fiscal Year 1975. Cowan, C. L. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Aug 1975. Contract AT(04-3)-893. 22p. AT.

The benchmark calculations for the Phase II testing of ENDF/B-IV (evaluated nuclear data file/B, version IV) were carried out and completed in accordance with the Cross-Section Evaluation Working Group (CSEWG) specifications. The benchmark calculations were performed for eight plutonium-fueled assemblies. A comparison of the calculated and experimental results indicates some general trends for data adjustment. The recommendations include a lower ^{238}U inelastic cross section between 0.5 and 2.0 MeV, a lower ^{238}U capture cross section, and higher delayed neutron fractions. Spectrum measurements in a uranium assembly carried out at Rensselaer Polytechnic Institute (RPI) indicate a lower inelastic cross section for ^{238}U than recommended by ENDF/B-IV. Testing of the RPI-modified inelastic data has been carried out for several fast reactor benchmark criticals. These modifications result in changes which generally improve agreement between calculated and measured results. The Processing Code Subcommittee of the Code Evaluation Working Group met in Washington, D.C., on March 2, 1975, to formulate the work plans and milestones for testing data processing codes. Two initial problems were selected. GE participation is based on TDOWN calculations starting with the generalized cross section file output from MINX. The burnup of actinides in LMFBRs is being investigated as a potentially important technique for disposal. An alternative to geological storage for disposal may be desirable. Recycling of actinides in LMFBRs should produce higher burnups than recycling in thermal reactors because the fission cross sections are relatively more important in a fast flux and is further favored by neutronics and fuel management considerations. To assess recycling in LMFBRs, the actinide isotopes which contribute most to the total actinide hazard have been identified, and a preliminary evaluation of nuclear data needs and availability has been made. Preliminary calculations indicate that actinide recycling in LMFBRs may significantly alleviate the long-term waste disposal problem associated with them. A benchmark study for a commercial size LMFBR has been initiated. (auth)

21549 (LA-DC-11039) NUCLEAR PHYSICS STUDIES WITH FAST NEUTRONS: A SURVEY. Hopkins, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1969. Contract W-7405-ENG-36. 212p. Dep. NTIS $8.75.

A survey of recent nuclear physics experiments with fast neutrons is presented. The survey is limited to those studies involving a neutron, with an energy greater than 0.5 MeV, in the entrance channel. Neutron capture is specifically excluded. The first part gives descriptions of 6 representative fast-neutron experimental techniques or facilities. In the second part, 11 specific fields are identified and reviewed. The fields are: (1) the nucleon-nucleon interaction, (2) total cross sections, (3) fluctuation phenomena, (4) elastic and inelastic scattering, (5) (n,2n) cross sections, (6) (n,charged particle) cross sections, (7) (n,x gamma) cross sections, (8) polarization, (9) electromagnetic neutron-nucleus interactions, (10) fission, and (11) high-energy phenomena. The final section contains a few brief comments regarding the directions that fast-neutron physics research may take in the future. (auth)

21550 (SGAE-2513) PROGRESS REPORT TO NEANDC AND INDC FROM AUSTRIA. Eder, O. J. (ed.). (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Forschungszentrum). Oct 1975. 8p. (PH-191/75). Dep. NTIS (US Sales Only) $3.50.

Abstracts of work performed in Austria are presented. Subjects covered include the following: neutron sources and neutron detection, nuclear reactions, $e-\nu$ angular correlations in neutron decay, determination of resonance self-shielding and resonance integrals, and reactor physics measurements. (RWR)

21551 ELECTROMAGNETIC INTERACTION IN NUCLEAR SPECTROSCOPY. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975). 941p. $108.50.

Separate abstracts have been prepared for each of 18 chapters for appearance in Nuclear Science Abstracts. (SDF)

For abstracts of individual chapters see: 20306, 20307, 21552–21557, and 21757–21766.

21552 EXPERIMENTAL TECHNIQUES OF CONVERSION COEFFICIENT MEASUREMENTS. Hamilton, J. H. (Vanderbilt Univ., Nashville). pp 441-504 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

An outline is given of selected techniques for measuring internal conversion coefficients and conversion coefficient ratios. Examples of spectra obtained and data analysis are considered. (31 figures, 5 tables) (SDF)

21553 GAMMA-RAY ANGULAR DISTRIBUTION AND CORRELATION MEASUREMENTS. I. Experimental Methods Using Radioactive Sources. Hamilton, W. D. (Univ. of Sussex, Brighton, Eng.). pp 645-700 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

The different methods that can be used in angular distribution and correlation measurements are considered. In addition to the general discussion, the problems in making measurements are emphasized and when appropriate a distinction is made between the statistical error on a result and those errors which are inherent in the experiment and which limit the accuracy of the measurement. (auth)

21554 GAMMA-RAY ANGULAR DISTRIBUTION AND CORRELATION MEASUREMENT. II. Experimental Methods Following Nuclear Reactions. Twin, P. J. (Univ. of Liverpool). pp 701-733 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

Angular correlations of γ-rays following nuclear reactions depend, in general, on some alignment of the γ emitting initial state. The alignment parameters are either calculated assuming some reaction mechanism, or treated as unknown parameters together with the multipole mixing ratios and spin sequences involved. These parameters have then to be determined from the information derived from the angular distributions. The methods of alignment are briefly discussed. The techniques and experimental methods associated with direct angular distributions, particle–γ correlations, $\gamma-\gamma$ correlations and linear polarization correlations are dealt with. Finally, the inherent ambiguities which arise when different spin and δ values give identical correlations are discussed for the simple direct and particle–γ correlations together with the question whether the larger information content of $\gamma-\gamma$ and linear polarization correlations can resolve these ambiguities. (7 figures, 2 tables) (auth)

21555 MEASUREMENT OF ELECTRIC AND MAGNETIC MOMENTS OF EXCITED STATES. Bodenstedt, E. (Univ., Bonn). pp 735-774 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

Problems of measuring electric and magnetic moments of excited states are detailed. Specific methods discussed are the classical method (rotation of angular correlations in an external magnetic field, integral observation), the spin rotation method, in-beam spin rotation, stroboscopic method, in-beam NMR, the use of hyperfine fields, and use of Moessbauer and reorientation effects. (4 tables, 22 figures) (SDF)

21556 GAMMA-RAY ENERGY AND INTENSITY MEASUREMENTS WITH Ge(Li) SPECTROMETERS. Helmer, R. G. (Science Applications, Inc., Rockville, MD); Cline, J. E.; Greenwood, R. C. pp 775-837 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

Consideration is given to the characteristics of Ge(Li) spectrom-

eters that are pertinent to the determination of γ-ray energies and intensities along with the associated data analysis methods. This discussion is in terms of data from good, commercially available Ge(Li) spectrometers. Such systems provide energy resolution of about 1 keV (FWHM) at 100 keV and <2 keV at 1 MeV. In considering the data analysis, some methods employed to give the most accurate results are discussed. For energies, these techniques should give a precision of a few eV, so that at most energies the major contribution to the total error is from the uncertainty in the calibration energies. For intensity measurements, accuracies of about 1% should be possible. To make full use of these characteristics of Ge(Li) spectrometers, it is essential that the experimenter be aware of the capabilities and limitations of the components of the system. Insofar as they relate to γ-ray energy and intensity measurements, these topics are discussed, but techniques related to other measurements (e.g., pulse timing for coincidence studies are not included. A general discussion of data analysis procedures is included. The last two sections give detailed descriptions of methods used in energy and intensity measurements. (20 figures, 11 tables) (auth)

21557 CURVED-CRYSTAL SPECTROMETERS: THEORY AND USE FOR γ-RAY ENERGY AND INTENSITY MEASUREMENTS. Reidy, J. J. (Univ. of Mississippi, University). pp 839-875 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

A discussion is given of the principle of operation of curved-crystal spectrometers with approximate focus and the methods of data acquisition and analysis using these instruments. Particular stress is laid on the DuMond spectrometer with some reference to the Cauchois type. It is this former instrument that has seen the greatest use for studies on nuclear γ-rays. One is capable of a precision of the order of 1×10^{-5} with this instrument and can achieve energy resolutions of the order of 30 eV at 100 keV. Source activities may be less than 100 μCi, energy measurements are straightforward, and the instrument may be automated conveniently. The cost of such an instrument is similar to that for a large-volume Ge(Li) spectrometer system. (1 table, 12 figures) (auth)

21558 TABLES OF NUCLEAR STRUCTURE AMPLITUDES FOR TWO-NUCLEON TRANSFER INVOLVING LIGHT PROJECTILES (A LESS THAN OR EQUAL TO 4). Glendenning, N. K. (Univ. of California, Berkeley). At. Data Nucl. Data Tables; 16: No. 1, 1-134(Jul 1975).

Tables are presented of values of the nuclear structure amplitudes required for construction of form factors for the reactions (alpha,d), (^{3}He,p), (^{3}He,n), (t,n), (t,p), and their inverses. (auth)

21559 NUCLEAR DATA SHEETS. Nucl. Data Sheets; 16: No. 4, vp(Dec 1975).

A bibliography of experimental nuclear reaction and structure articles along with key numbers, key words, and a reaction index are compiled for December 16, 1974 through August 15, 1975. (SDF)

21560 SUPERALLOWED 0^+ yields 0^+ AND ISOSPIN-FORBIDDEN J/sup pi/ yields J/sup pi/ FERMI TRANSITIONS. Raman, S. (Oak Ridge National Lab., TN); Walkiewicz, T. A.; Behrens, H. At. Data Nucl. Data Tables; 16: No. 5, 451-494(Nov 1975).

Experimental data on Q-values, beta end-point energies, half-lives, and branching ratios pertaining to superallowed 0^+ yields 0^+ beta-transitions are compiled and evaluated. Out of a total of eighteen Ft values, seven are known to better than 0.3 percent accuracy. The weighted average of all values, Ft equals 3088.6 +- 2.1 sec, was employed to determine the effective vector coupling constant G'/sub V/ equals $(1.4115 \pm 0.0005) \times 10^{-49}$ erg cm^3. Experimental data on beta-transitions between states of same spin but different isospin are also compiled and evaluated if they yield Fermi matrix elements. Information is obtained on isospin impurities of thirty-three nuclear states ad deduced from beta-decay experiments. The isospin impurities are extremely small, the largest being 0.05 percent reported for the ^{64}Ga ground state. The literature survey ended in April 1975. 9 tables, 4 figures. (auth)

21561 NUCLEAR DATA SHEETS. Nucl. Data Sheets; 16: No. Suppl., 1-494(1975).

A bibliography of experimental nuclear reaction and structure articles along with key numbers, key words, and a reaction index are compiled for period 1969-1974. (SDF)

Neutron Interactions with Matter

Refer also to abstracts 20282, 21709, 21809, 21810, 21850, 22209, and 22508.

21562 (LA-5987) CONSISTENCY AMONG DIFFERENTIAL NUCLEAR DATA AND INTEGRAL OBSERVATIONS: THE ALVIN CODE FOR DATA ADJUSTMENT, FOR SENSITIVITY CALCULATIONS, AND FOR IDENTIFICATION OF INCONSISTENT DATA. Harris, D. R.; Reupke, W. A.; Wilson, W. B. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1975. Contract W-7405-Eng-36. 33p. Dep. NTIS $5.00.

Successful nuclear design requires adequate prediction of integral design parameters, and this in turn requires an adequate differential nuclear data base. Data bases that apparently permit reduced biases and design margins have been developed by a) least squares adjustment of differential data or b) trial-and-error selection from alternative evaluated data sets. Criticisms and defenses of such procedures are discussed. Useful data adjustment is related to consistency of the combined differential-integral data set and consistency tests related to least squares adjustment procedures are described. An approach to data adjustment is suggested that is contingent on consistency analysis. A FORTRAN code ALVIN has been developed to carry out the indicated data consistency and adjustment calculations, and to compute required sensitivities of integral parameters to nuclear data changes. The sensitivity modules of ALVIN are validated by computing with two distinct methods the cross-section sensitivity profile for neutron penetration through a thick iron shield. The data consistency and adjustment modules DAFT2 (for arbitrary variance-covariance data) and DAFT3 (for differential data base of arbitrary size uncorrelated with integral data) are validated by comparing their results for a set of data for three ZPR criticals. 2 figures, 5 tables, 51 references. (auth)

21563 NEUTRON TRANSPORT WITH HIGHLY ANISOTROPIC SCATTERING. Odom, J. P. Manhattan, KS; Kansas State Univ. (1975). 166p. University Microfilms Order No. 75-25,054. Thesis (Ph. D.).

This study represents an investigation into computational techniques for particle transport involving highly anisotropic scattering phenomena. In this method the scattering function takes the form of a scattering matrix whose elements are the actual scattering function evaluated at discrete values of the cosine of the scattering angle in the laboratory system. For this purpose, multigroup scattering cross sections are evaluated directly from a rigorous mathematical expression for the multigroup scattering cross section. A computer code is presented which efficiently generates the multigroup scattering cross sections from point microscopic data. The code is applied to the generation of multigroup cross sections for hydrogen, oxygen, and water scattering. To use the non-expanded scattering cross sections in transport calculations, a modified discrete ordinates, segmented angle method is formulated. Specifically, the in-scattering source term is computed numerically using a scattering matrix whose elements are evaluated at numerical quadrature angles. This non-expansion technique was incorporated into computer codes which are designed to treat the azimuthally symmetric and the azimuthally dependent multigroup cases of the albedo transport problem in one-dimensional, slab geometry. The non-expanded cross sections are used in the computer codes developed in this work to predict the angular density in several one-speed neutron transport problems and in several multigroup treatments of neutron transport in realistic situations. Significant improvement in the calculation of the angular density is evidenced by comparison of the non-expansion method results with results from the widely used code, ANISN. Finally the computer codes developed in this work are applied to the preliminary design of a cross section analysis experiment. It is expected that the methods introduced in this work may be of use in highly anisotropic scattering from light nuclei or for hyperfine multigroup calculations. (Diss. Abstr. Int., B)

21564 TWO-HALF-SPACE MILNE PROBLEM IN TWO-GROUP NEUTRON TRANSPORT THEORY. Ishiguro, Y.; Maiorino, R. (Cidade Univ., Sao Paulo, Brazil). Trans. Am. Nucl. Soc.; 22: 253-254(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21565 NONLINEAR ANALYSIS PROCEDURE FOR EVALUATION OF RESONANCE RANGE CAPTURE CROSS SECTIONS. Steen, N. M. (Bettis Atomic Power Lab., West Mifflin, PA). Trans. Am. Nucl. Soc.; 22: 662-663(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21566 SELF-SHIELDED CROSS SECTIONS FOR NEUTRON TRANSPORT IN IRON. MacFarlane, R. E. (Los Alamos Scientific Lab., NM); Becker, M. Trans. Am. Nucl. Soc.; 22: 668-669 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21567 HOW ACCURATE ARE SELF-SHIELDING FACTORS. Segev, M. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 711-712(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21568 CRITICAL EXAMINATION OF LOW-ORDER QUADRATURES FOR STATISTICAL INTEGRATIONS. Hwang, R. N.; Henryson, H. II. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 712-713(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21569 MONTE CARLO STUDIES OF TARGET/MODERATOR CONFIGURATIONS FOR THE WEAPONS NEUTRON RESEARCH FACILITY. Russell, G. J.; Seeger, P. A.; Fluharty, R. G. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 715-716(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21570 NEUTRON SPECTRUM FROM AN ENRICHED ^{235}U SPHERE. Ragan, C. E.; Auchampaugh, G. F.; Silbert, M. G.; Hemmendinger, A.; Hunter, R. E.; Taylor, W. M. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 716-717(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21571 DIRECT DATA ADJUSTMENT FOR ^{238}U BY INTERACTIVE GRAPHICS COMPUTING. Parvez, A.; Becker, M. (Renssaelaer Polytechnic Inst., Troy, NY). Trans. Am. Nucl. Soc.; 22: 717-718(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21572 NJOY: A NEUTRON AND PHOTON CROSS-SECTION PROCESSING SYSTEM. MacFarlane, R. E.; Boicourt, R. M. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 720(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21573 INVESTIGATION OF ^{238}U INTERMEDIATE STRUCTURE IMPORTANCE. Burns, T. J.; Weisbin, C. R. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 724-726(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21574 EVALUATION OF INTERMEDIATE ENERGY (LOW keV) ^{238}U NUCLEAR DATA BASED ON INTEGRAL MEASUREMENTS. Bates, A. L.; Malaviya, B. L. (Rensselaer Polytechnic Inst., Troy, NY). Trans. Am. Nucl. Soc.; 22: 728-729(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21575 SMOOTHING IN THE FERDOR METHOD OF NEUTRON SPECTRUM UNFOLDING. Johnson, R. H.; Wehring, B. W.; Dorning, J. J. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 798-799(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21576 INTEGRAL TESTS OF NEUTRON CROSS SECTIONS FOR IRON ABOVE 1.0 MeV. Johnson, R. H.; Dorning, J. J.; Wehring, B. W. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 799-800(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21577 MEASURED AND CALCULATED FAST-NEUTRON SPECTRA IN A GRAPHITE MEDIUM. Smith, W. R. Jr.; Draper, E. L. Jr. (Univ. of Texas, Austin). Trans. Am. Nucl. Soc.; 22: 800-801(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21578 FAST-NEUTRON TRANSMISSION NEAR CROSS-SECTION MINIMA. Lindahl, S. O.; Shultis, J. K. (Kansas State Univ., Manhattan). Trans. Am. Nucl. Soc.; 22: 809-810(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21579 METHOD TO CALCULATE INDUCED RADIOACTIVITY USING EXISTING TRANSPORT CODES. Wilcox, T. P. (Univ. of California, Livermore). Trans. Am. Nucl. Soc.; 22: 816(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21580 PRODUCTION CROSS SECTIONS FOR DISCRETE γ RAYS FROM COPPER AND SILICON. Rogers, V. C. (IRT Corp., San Diego, CA); Dixon, D. R.; Hoot, C. G.; Orphan, V. J.; Costello, C. G.; Sandquist, G. M. Trans. Am. Nucl. Soc.; 22: 817-818(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21581 14-MeV CROSS-SECTION MEASUREMENTS OF THRESHOLD REACTIONS FOR SEVEN METALS. Spangler, R.; Draper, E. L. Jr.; Parish, T. A. (Univ. of Texas, Austin). Trans. Am. Nucl. Soc.; 22: 818-819(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21582 DEVELOPMENT, GENERATION, AND TESTING OF THE DCTR FINE-GROUP CROSS-SECTION LIBRARY. Roussin, R. W. (Oak Ridge National Lab., TN); Weisbin, C. R.; White, J. E.; Greene, N. M.; Johnson, R. H. Trans. Am. Nucl. Soc.; 22: 820-821(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21583 FICTITIOUS SCATTERING MULTIGROUP CROSS SECTIONS. Cramer, S. N.; Engle, W. W. Jr. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 821(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21584 SPECTRA AND DOSIMETRY OF NEUTRONS FROM VARIOUS SOURCES SHIELDED BY IRON. Ing, H.; Cross, W. G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Sci. Eng.; 58: No. 4, 420-430(Dec 1975).
Spectra, calculated by Monte Carlo, are presented for neutrons transmitted through various thicknesses of iron from sources of fission neutrons, H_2O-moderated fission neutrons, D_2O-moderated fission neutrons, and 14.7-MeV neutrons. The sources were located at the center of iron spheres or were in the form of beams incident normally on slabs. Variations in spectral shapes are discussed from the viewpoint of effects on the response of neutron dosimeters. Effective cross sections (sigma-bar) for threshold detectors ^{103}Rh, ^{115}In, ^{32}S, ^{237}Np, ^{232}Th, and ^{238}U were obtained by averaging the cross sections over the calculated spectra. Average kerma (K-bar), dose equivalent, and maximum dose per n/cm^2 were also calculated. Curves of sigma-bar/K-bar show the sensitivity of these detectors to spectral changes and permit the computation of correction factors to dosimeter readings. 15 figures. (auth)

21585 THERMAL-NEUTRON FLUX DISTRIBUTION IN CUBICAL CAVITIES FROM AN ISOTOPIC NEUTRON SOURCE. Bartko, J. (Westinghouse Research Labs., Pittsburgh). Nucl. Technol.; 27: No. 3, 511-513(Nov 1975).
The thermal-neutron flux magnitude and distribution were measured in large cubical cavities for a bare and paraffin-covered ^{241}Am-Be neutron source situated in the center. The flux at a specific location in each cavity was found to be proportional to the inverse surface area of the cavity. The thermal-neutron flux/fast-neutron flux at each location was found to be essentially constant for the range of cube sizes under study. 5 figures. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 21492, 21609, and 21774.

21586 (IPNO/TH-75-7) OFF-SHELL AND MULTIPLE SCATTERING EFFECTS IN THE $p + {}^2H \rightarrow 2p + n$ REACTION AT 156 MeV. L'Huillier, M.; Benoist-Gueutal, P.; Ballot, J. L. (Paris-11 Univ., 91- Orsay (France). Inst. de Physique Nucleaire). Mar 1975. 47p. Dep. NTIS (US Sales Only) $4.00.
The nucleon-deuteron breakup reaction is analysed in the framework of a model of single and double scattering using the off-shell t-matrix elements corresponding to several realistic local two-nucleon potentials. The multiple scattering contributions are estimated through a model derived from a fixed scattering centers approximation with a simple, separable two-body t-matrix. (11 figures) (auth)

21587 (LYCEN-7502, pp C.3.1-C.3.11) GIANT ISOSCALAR RESONANCES IN LIGHT NUCLEI. Abgrall, Y. (Bordeaux Univ.); Caurier, E. 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69—Villeurbanne (France). Inst. de Physique Nucleaire).

A hydrodynamic description of giant resonances is given. The vibrational states of ^{4}He, ^{16}O, and ^{40}Ca which appear in the region of the giant dipole resonances are examined. (BJG)

21588 (LYCEN-7502, pp S.9.1-S.9.4) GROUND STATE OF ^{4}He AND ELECTRON SCATTERING. Caurier, E. (CRN, Strasbourg). 1975. (In French)

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).

Experiments on electron scattering on ^{4}He has shown the existence at high transfer of a diffraction minimum in the form factor. Theoretical attempts to obtain a correct form factor have met with indifferent success. The Hill method of the coordinated generatrix was applied to this problem. A microscopic theory was developed which has the advantage of including simultaneously, in the case of ^{4}He, short- and long-range correlations and allowing an exact elimination of parasite states. (JSR)

21589 SCATTERING FROM NONOVERLAPPING POTENTIALS. III. PION ELASTIC SCATTERING ON ^{4}He IN THE 3,3 REGION. Agassi, D. (Department of Physics, Weizmann Institute of Science, Rehovot, Israel); Gal, A. Ann. Phys. (N.Y.) 94: No. 1, 184-205 (19 Sept 1975).

The π^- ^{4}He elastic scattering in the 3,3 resonance region is discussed in the framework of the nonoveralpping potentials model. Single and double scattering terms are considered together with their modification by reflection terms, which allow the projectile to oscillate back and forth an arbitrary number of times within a pair of necleons. Reflections and spin and isospin flips are found to constitute a determining factor in a qualitative reproduction of the correct shape of observed angular distributions, in particular for backward scattering angles. Reflections are probably unimporatnt in πd scattering. (auth)

21590 EFFECT OF THE EXCHANGE PART OF TENSOR FORCES ON THE SUM RULE FOR ELECTRON SCATTERING BY d AND ^{4}He NUCLEI. Roshchupkin, S. N.; Inopin, E. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 11, 1872-1877(Nov 1975). (In Russian).

The effect of central and tensor exchange forces is considered as applied to the sum rules for electron scattering by d and ^{4}He nuclei. The evaluation of the contribution of central and tensor exchange forces shows that the tensor forces in ^{4}He are thrice as high as the corresponding forces in d. A relative contribution of the central exchange forces to the tensor exchange forces is the same for both d and ^{4}He and is approximately equal to three. It is shown that for ^{4}He the correction total value determined by the central and tensor exchange force is the same as in case of medium and heavy nuclei. (auth)

21591 INVESTIGATION OF LANDAU SINGULARITIES OF A TWO-CONTOUR FEYNMAN DIAGRAM IN THE AMPLITUDE OF NUCLEON SCATTERING BY A DEUTERON. Dubovoi, E.I.; Golyshkov, V. A. (Inst. of Radio-Engineering, Moscow). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 142-146(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 161-166(1975).

The principal difficulty in applying the method of nonrelativistic Feynman diagrams to a description of nuclear reactions consists in selecting a sufficiently small number of summed diagrams which determine the character of the behavior and the magnitude of the differential cross section. The guiding star in the solution of this fundamental problem in diagram theory of nuclear reactions is currently the hypothesis of the definitive role played by those diagrams whose singularities are closest to the investigated domain of kinematic variables. Whereas the positions of the singularities of polar and triangular diagrams in Nd-scattering is known, the problem of the analytic properties of the two-contour diagram has remained open. The present paper is devoted to the investigation of the analytic properties of this diagram which describes double rescattering of nucleons, and its role in describing elastic Nd-scattering and the reaction of deuteron breakup. (auth)

21592 ELECTRODISINTEGRATION OF ^{3}He. Kan, P.T.K. Amherst, MA; Univ. of Massachusetts (1975). 148p. University Microfilms Order No. 75-27,539.

Thesis (Ph. D.).

The continuum spectra of ^{3}He have been measured up to excitation energies of 40 MeV by means of inelastic electron scattering. The experiment was performed at the 140 MeV linear electron accelerator facility of the National Bureau of Standards, Gaithersburg, Maryland. The following incident-electron energies were used: 60, 75, 90, 110 and 120 MeV; the corresponding momentum transfer range was from 0.3 to 1.1 fm^{-1}. Electrons scattered were observed at two angles, 92.6^0 and 127.7^0. A gas target pressurized to 10 atmospheres with ^{3}He was used in the experiment. Data were also taken on an empty target of identical construction for subtraction of backgrounds. A Cerenkov counter was used as a back-up detector, in order to reduce the sensitivity of the counting system to background neutrons. The measured spectra were corrected for radiation and ionization effects, and a calculated elastic radiation tail was subtracted from the data, before a bin-by-bin radiation unfolding was applied to the continuum spectra. The unfolded data were presented, and compared with photodisintegration and 180^0 electron scattering experiments. The predominant transitions were found to be E1 and E2. Some magnetic strength was also present, but its multipole assignment has not been firmly established. The sharp rise from the p + d threshold observed in this experiment could be explained as a ^{2}S yields ^{2}S electric monopole transition, in a simple model of a proton bound to a deuteron. (Diss. Abstr. Int., B)

21593 ISOSPIN VIOLATION IN THE ^{12}C(^{6}Li, alpha)^{14}N (2,31 MeV) REACTION. Sokol, J. P. Notre Dame, IN; Univ. of Notre Dame (1975). 124p. University Microfilms Order No. 75-19,955.

Thesis (Ph. D.).

The isospin violating reaction ^{12}C(^{6}Li, alpha)^{14}N (2,31 MeV) has been investigated in the range of lithium beam energies from 9,0 to 14,0 MeV. Excitation functions were measured for the ground state, 2,31-MeV state and 3,95-MeV state of ^{14}N at 15^0, 20^0, 60^0 and 160^0 in the lab. An excitation function at 40^0 lab was taken for the ground state and 3,95-MeV state of ^{14}N. Angular distributions were obtained at 10,5, 11,25, 13,75 and 20,0-MeV beam energies. The data were taken using a 50 cm. broad-range magnetic spectrograph with a position-sensitive proportional counter in the focal plane, and with solid state detectors in the Ortec scattering chamber. Special isotopically pure carbon targets were used to eliminate the ^{13}C contaminant. The results indicate a 1,2 to 4,5 percent yield to the 2,31-MeV isospin forbidden state as compared to the allowed ground state and 3,95-MeV state in the energy region of 9 to 14 MeV lithium beam energy. At 20,0 MeV the yield to the forbidden state is only 0,1 percent the allowed yield. Isospin mixing by the Coulomb force is believed responsible for the forbidden yield seen between 9-14 MeV. No observation was made of a direct-reaction isospin violating mechanism. The results for ^{12}C(^{6}Li, alpha)^{14}N for the first three states in ^{14}N with beam energies of 9-14 MeV are compared with the available data from ^{16}O(d, alpha)^{14}N and ^{14}N(alpha, alpha')^{14}N in the same region of the compound nucleus. (Diss. Abstr. Int., B)

21594 PROTON-PROTON ANALYZING POWER MEASUREMENTS AT 16 MeV. Lovoi, P. A. Albuquerque, NM; Univ. of New Mexico (1975). 108p. University Microfilms Order No. 75-28,723.

Thesis (Ph. D.).

Few attempts have been made to measure accurately the proton-proton analyzing powers at low energies. With the advent of polarized particle beams the measurement can now be made with high accuracy. Analyzing powers were measured at nine scattering angles from 10^0 to 35^0 in the laboratory system. As a check on systematic errors, analyzing power measurements were also made by scattering protons from ^{4}He. In the p vector-p case the measured values are in very good agreement with the phase shift predictions. The p vector-^{4}He measurements, while giving the same form and sign as the phase shift predictions, differ from the predictions by as much as 11 standard deviations. The p vector-p analyzing powers had a maximum value of -0,0043 +- 0,0004 at 10^0 (laboratory) and decreased to zero near 25^0. A new technique to measure analyzing powers without symmetric detectors is explained. This technique preserves the advantages of the symmetric arm method in that current integration, target density, detector efficiencies, and geometry are cancelled from the final expressions. A new scattering chamber, named the Supercube, is described. The Supercube was designed primarily to perform scattering experiments with a polarized beam. It contains both left-right and up-down detectors for use with both spin-½ and spin-1 measurements. The Supercube was designed to make analyzing power measurements to an accuracy of 0,001 routine. The Supercube has proved to have low systematic errors and to perform as expected. The systematic errors were found to be equal to or less than 0,0002. (Diss. Abstr. Int., B)

21595 DIFFERENTIAL CROSS SECTIONS FOR THE ^{10}B(n, alpha)^{7}Li, ^{7}Li* REACTIONS. Sealock, R. M. Eugene, OR; Univ. of Oregon (1975). 78p. University Microfilms Order No. 75-18,745.

Thesis (Ph. D.).

The usefulness of the ^{10}B(n, alpha)^{7}Li, ^{7}Li* reactions for neutron detectors and flux standards justifies efforts to obtain a more accurate knowledge of integrated and differential cross sections. Measurements of alpha-particle yields from these reactions have

been made at 8 angles from 0^0 to 150^0 for neutron energies from 200 to 1250 keV. The neutron source was a thick natural lithium target bombarded by a 3.0 MeV pulsed proton beam. An evacuated, low-mass target chamber housed the ^{10}B target and a silicon surface barrier detector. The detector was used to measure alpha-particle energies and to provide a timing signal. This timing signal and another derived from a ferrite core beam pulse pickoff were used to measure the total flight time of the neutrons and resultant alpha particles. When counts were stored in a two-dimensional array of total flight time versus energy, ground state and first excited state alpha particles were separated from background as well as from each other. Yields were converted to differential cross sections at calculated mean reaction angles and neutron energies. Angular distributions were least fitted to a sum of Legendre polynomials for 22 neutron energies. The coefficients of the P_0 terms have been used to calculate integrated cross sections, absorption cross sections, and branching ratios. These agree, within errors, with other measurements except for a broad peak at 350 keV in the ground state cross sections not seen by others. The coefficients of the P_1 terms for both reactions indicate interference between a p-wave state at E/sub n/ equals 530 keV and nearby s-wave states. A four term fit was required for the first excited state reaction for E/sub n/ equals 300 to 500 keV, suggesting the presence of a d-wave state. (Diss. Abstr. Int., B)

21596 MEASUREMENT OF p-T AND p-^{3}He ELASTIC SCATTERING ANALYZING POWERS BELOW 4 MeV. Volkers, J. C. Columbus, OH; Ohio State Univ. (1975). 122p. University Microfilms Order No. 75-19,499.

Thesis (Ph. D.).

The analyzing powers for p-T elastic scattering have been measured for E/sub p/ from 1.9 to 3.9 MeV. For p-^{3}He elastic scattering, the analyzing powers have been measured for E/sub p/ from 2.1 to 3.74 MeV. These measurements were made using the polarized beam from the Ohio State University single-ended Van de Graaff accelerator. The beam polarization was typically 0.60, with intensities of approximately 30 nA. The polarization was monitored using a ^{4}He polarimeter. The data were taken at four angles simultaneously using four pairs of symmetric detectors. The scattering chamber was rotated 180^0 about the beam axis to effect a spin-flip for detector normalization. These data are much more accurate than any previously taken at these energies; all previous data were taken using double-scattering techniques. In addition to a discussion of the data, a description of the polarized source and a discussion of developments and improvements not covered in previous works is given, together with a description of the experimental apparatus and techniques used. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 21587 and 21768.

21597 (AAEC/E-359) NEUTRON YIELDS AND ENERGY SPECTRA FROM THE THICK TARGET Li(p,n) SOURCE. Ritchie, A. I. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1975. 19p. Dep. NTIS (US Sales Only) $3.50.

Angle-dependent spectra of neutrons, emitted by a thick lithium target when bombarded with protons in the energy range 1.881 to 3 MeV, have been evaluated from experimental and theoretical values of the angular distribution of neutrons emitted in the ^{7}Li(p,n)^{7}Be reaction. The variation of $d^2N/dE_n d\Omega$ with proton energy at different angles of emission, and with angle of emission for different neutron energies, is presented for the ground and excited state reactions. The angle-integrated neutron spectrum is given for different incident proton energies. (7 figures, 1 table) (auth)

21598 (ORNL-TM-5204) SB3. Experiment on Secondary Gamma-Ray Production Cross Sections Averaged Over a Fast-Neutron Spectrum for Each of 13 Different Elements Plus a Stainless Steel. Maerker, R. E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 36p. (ENDF-228). Dep. NTIS $5.00.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. This particular experiment measured the secondary gamma-ray production cross sections averaged over a fast-neutron spectrum for iron, oxygen, sodium, aluminum, copper, titanium, calcium, potassium, silicon, nickel, zinc, barium, sulfur, and a type 321 stainless steel. The gamma-ray production cross sections were binned into 0.5-MeV wide gamma-ray energy intervals. 29 tables, 1 figure (auth)

21599 SEARCH FOR HIGH SPIN STATES IN LIGHT RIGID NUCLEI. Hadsell, R. W. New Haven; Yale Univ. (1975). 79p. University Microfilms Order No. 75-24,544.

Thesis (Ph. D.).

To test the validity of macroscopic and microscopic nuclear models with respect to their description of states having large angular momentum, a search for previously unobserved high spin states of nuclei in the mass region A equals 21-23 was conducted. In particular, it has been expected that the prediction of rotational band termination, made by microscopic models with truncated configuration spaces, could be compared with observations of states lying near or perhaps even above the predicted termination. The nuclei ^{21}Ne, ^{22}Ne, and ^{23}Na were investigated using the reactions ^{9}Be(^{16}O,d gamma)^{23}Na, ^{9}Be(^{16}O, alpha gamma)^{21}Ne, ^{12}C(^{12}C, alpha gamma)^{21}Ne, and ^{12}C(^{12}C, alpha gamma)^{22}Ne. Particle detection efficiency was increased, without allowing angle-dependent energy shifts to degrade the resolution, by employing a radially position-sensitive detector subtending emission angles from 0^0 to 15^0. Coincidence observations utilized both NaI and Ge(Li) detectors for the gamma rays, and angular correlations in the Litherland-Ferguson Method II geometry were measured for states in ^{22}Ne. Contrary to expectations, only the reaction ^{9}Be(^{16}O,d)^{23}Na appeared to populate high spin states selectively in the residual nucleus. Furthermore, no new members of the ground-state rotational bands could be identified. Failure to observe the gamma decay of the expected $^{15}/_2^+$ member of the groundstate band in ^{21}Ne leads to the suggestion that such a state decays primarily by alpha or neutron emission. The measurements reported here unfortunately indicate that heavy-ion induced reactions will be somewhat less useful in probing high angular momentum nuclear configurations than earlier, more preliminary measurements have suggested. (Diss. Abstr. Int., B)

21600 NATURE OF HIGH ENERGY PEAKS IN THE CROSS SECTIONS OF COLLISIONS OF NEUTRONS WITH ^{12}C NUCLEI. Nikolaev, M. V.; Ol'khovskii, V. S.; Totskii, Ya. I.; Chinarov, V. A. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 11, 1882-1884(Nov 1975). (In Russian).

Using the model of three quasi-particle states which arise due to the excitations of impurity configurations of the ground states of the target-nucleus and trapping of the neutron, the energies, widths and spins of the resonance peaks in ^{12}C(n,p)^{12}B reaction cross section at E_n = 16-18 MeV are calculated. (auth)

21601 REACTION OF (d,^{6}Li) TYPE ON ^{12}C NUCLEI WITH DEUTERON ENERGY 13.2 AND 12.7 MeV. Goryunov, O. Yu.; Dobrikov, V. N.; Nemets, O. F.; Reuk, E. P.; Rudchik, A. T. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 11, 1775-1780(Nov 1975). (In Russian).

Differential cross sections of the reaction ^{12}C(d,^{6}Li)^{8}Be$_{ground}$ are measured at E_d = 13.2 and 12.7 MeV. The results of analysis of the reaction cross sections at E_d = 13.6, 13.2 and 12.7 MeV based on the theory of α-particle pick-up are presented in approximation of the distorted waves with a zero radius of interaction. (auth)

21602 CHARGE FORM FACTORS OF NUCLEI IN THE α-CLUSTER MODEL WITH PROJECTION. Inopin, E. V.; Kinchakov, V. S.; Luk'yanov, V. K.; Pol, Yu. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 46-58(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 55-69(1975).

Within the framework of the alpha cluster model with projection expressions have been derived for the charge form factors of elastic and inelastic electron scattering by α-cluster nuclei. The numerical calculations were performed with nucleon trial functions having Gaussian and exponential asymptotics. The model describes the form factors of the ^{12}C, ^{16}O, ^{24}Mg, ^{28}Si, ^{32}S, and ^{40}Ca nuclei with good accuracy. Calculations show that the model cannot yield a unique description of the form factors of p-shell nuclei. (10 figures, 5 tables) (auth)

21603 NEUTRON PICKUP BY ALPHA PARTICLES TO UNBOUND STATES. Brown, D. R. Seattle; Univ. of Washington (1975). 282p. University Microfilms Order No. 75-28,327.

Thesis (Ph. D.).

The coincidence spectra of alpha particles and neutrons emitted from several targets during bombardment with 42 MeV and 90 MeV alpha particles have been measured at several pairs of angles. With a ^{208}Pb target, a conspicuous peaking of events which leave ^{207}Pb in or near its ground state is shown to have an energy-angle correlation expected for the breakup products of the unstable ^{5}He/sup g.s./. In the spectra measured at 90 MeV bombarding

energy with small angular separations between the detectors, numerous other events are seen. Observed structure in the distribution of these events is shown to have the expected energy-angle correlation for the breakup products of ^{6}He*(1.8 MeV). From the data with the detectors nearly coaligned, the differential cross sections for the (alpha, ^{5}He/sup g.s./) and (alpha, ^{6}He*(1.8 MeV)) reactions with ^{12}C, ^{103}Rh, ^{208}Pb and /sup nat/U are deduced. The differential cross sections for the (alpha, ^{5}He/sup g.s./) reaction are comparable in size to those for the (p,d) reaction and are well explained by DWBA calculations. The cross section observed for this reaction can explain a large portion of a bump-like structure that had been seen in the forward angle (alpha,alpha') spectrum measured at 90 MeV. The differential cross section for the (alpha, ^{6}He*(1.8 MeV)) reactions are about 1/4 as large as those for the (p,t) reaction on similar targets. (Diss. Abstr. Int., B)

21604 (π^{+},p) REACTION IN ^{12}C. Bhalerao, R. S.; Waghmare, Y. R. (Indian Inst. of Tech., Kanpur). Pramana; 5: No. 3, 154-161(Sep 1975).

Hartree-Fock wave functions obtained from realistic nucleon-nucleon interaction are employed to calculate cross-sections for the reaction ^{12}C(π^{+},p)^{11}C(g.s.). These wave functions take into account central correlations between nucleons inside the nucleus. This itself is found to change the cross section by more than an order of magnitude. The incoming pion is represented by a plane wave while proton-distortion is taken into account in the high-energy or semi-classical approximation, thereby determining the proton optical well parameters. These values agree well with those obtained by more conventional methods. Variation of the cross section with the oscillator well parameter is also studied. Calculations have been made using the one-nucleon mechanism for the pion-absorption process. (2 figures, 3 tables) (auth)

21605 I. STUDY OF SOME BETA DECAYS IN THE SD SHELL. II. COMPARISON OF EXPERIMENTAL REACTION CROSS SECTIONS WITH THE HAUSER–FESHBACH MODEL. Mann, F. M. Pasadena, CA; California Inst. of Tech. (1975). 368p. University Microfilms Order No. 75-20,002.

Thesis (Ph. D.).

I: The beta decays of ^{19}Ne, ^{23}Mg, ^{27}Si, ^{37}K, ^{38}K, and ^{39}Ca have been studied by observing the delayed gamma radiation with large volume Ge(Li) detectors. A pneumatic shuttle was used so that weak beta transitions could be observed. Two previously unobserved allowed transitions have been found, and the uncertainty for most of the previously known transitions has been reduced. Limits for unobserved transitions have been strengthened. A comparison is made between the predictions of various nuclear models, particularly the many-particle shell model, and observed values. II: Cross sections have been measured by the activation method for ^{23}Na(p,n)^{23}Mg, ^{35}Cl(alpha, n)^{38}K, and ^{63}Cu(p,n)^{63}Zn from threshold to 11 MeV and for ^{59}Co(alpha, n)^{62}Cu, ^{63}Cu(alpha, n)^{66}Ga, and ^{65}Cu(alpha, n)^{68}Ga from threshold to 19 MeV. The excitation functions are compared with the predictions of the Hauser-Feshbach model of nuclear reactions. If resonance effects are averaged, then using established parameters for the nuclear potentials and for the nuclear level densities, the predicted values are within a factor of 2 of the experimental values for practically all cross sections measured. For cases where direct reactions are not important, agreement to within 20 percent is obtained. (Diss. Abstr. Int., B)

21606 MULTI-NUCLEON TRANSFER REACTIONS ON LIGHT NUCLEI. Vander Molen, A. M. Ann Arbor, MI; Univ. of Michigan (1975). 125p. University Microfilms Order No. 75-20,467.

Thesis (Ph. D.).

A study was made to ascertain the feasibility of using The University of Michigan 83-inch cyclotron for heavy-ion research. The problems associated with the production, acceleration, and the detection of heavy ions were investigated. Particular emphasis was given to an analogue particle identifier. The results of work, done with a 125-MeV $^{12}C^{++++}$ beam, clearly showed the possibility of such research and were applied to the study of two reactions involving heavy ions. The reactions ^{16,18}O(^{4}He,^{6}He)^{14,16}O were investigated at 58 MeV. The data from this experiment were analyzed using the distorted-waves Born approximation (DWBA) in zero-range and were compared with the similar (p,t) reaction. This comparison resulted in a better understanding of the reaction mechanism for this two-neutron transfer reaction. The (d,^{6}Li) alpha-transfer reaction was investigated on several light nuclei. These data were analyzed using both a zero-range and finite-range DWBA code. The resultant alpha-particle spectroscopic factors were compared to theoretical predictions based on the SU_3 shell model formalism. The comparison shows good agreement and no additional alpha-particle correlations are required to explain the data. The five- and six-nucleon transfer reactions (d,^{7}Li) and (d,^{8}Li) were also observed. (Diss. Abstr. Int., B)

21607 EXCITON MODEL ANALYSIS OF (p,α) REACTIONS INDUCED IN ODD LIGHT NUCLEI. Gadioli, E.; Erba, E. G.; Iori, I. (Univ., Milan). Lett. Nuovo Cim.; 15: No. 3, 83-87 (17 Jan 1976).

The evaluation of the excitation functions of (p,α) reactions on ^{11}B, ^{15}N, and ^{19}F are reported for transitions to definite levels of the residual nucleus. The calculations make use of the decay rates for exciton–exciton interaction evaluated with the semi-phenomenological approach. (JFP)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 21587, 21598, 21599, 21602, 21605, 21718, 21721, 21771, and 21803.

21608 (COO-2324-5) RECOIL PROPERTIES OF ^{11}C AND ^{18}F PRODUCED IN THE INTERACTION OF 1- TO 11.5-GeV PROTONS WITH ^{27}Al. Progress Report. (Illinois Univ., Chicago (USA)). [nd]. Contract E(11-1)-2324. 13p. Dep. NTIS $3.50.

This work is a continuation of the recoil study of radioactive products from the proton bombardment of Al. Recoil properties of ^{11}C and ^{18}F are reported for proton energies of 1, 3, 6, and 11.5 GeV. Values of 2W(F+B) are tabulated and plotted. 2 figures, 4 tables (RWR)

21609 (LYCEN-7502, pp S.8.1-S.8.4) TRANSITION PROBABILITIES FROM EXCITED STATES OF ^{36}Cl AND ^{36}Ar IN HEAVY ION REACTIONS. Costa, G. J.; Alexander, T. K.; Forster, J. S.; McDonald, A. B.; Towner, I. S. (Chalk River Nuclear Labs., Ont.). 1975. (In French).

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

The mean lives of several excited states of ^{36}Cl and ^{36}Ar were measured by the recoil distance method. The experimental technique is briefly described. The results obtained are tabulated and compared with other experimental results. (JSR)

21610 (LYCEN-7504) ELASTIC AND INELASTIC PROTON SCATTERING FROM ^{21}Ne AND T = 1 ENERGY LEVELS IN ^{22}Na. Chambon, B.; Desgrolard, P.; Drain, D.; Lambert, M.; Persehaye, N. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire). Jan 1975. 32p. Dep. NTIS (US Sales Only) $4.00.

Excitation functions for the reactions ^{21}Ne(p,p) and ^{21}Ne(p,p') were studied at 8 angles for bombarding energies in the range E_p = 0.6 – 2.0 MeV. A total of 21 resonances was observed corresponding to ^{22}Na levels between 7.3 and 8.6 MeV excitation energy. The proton angular momenta are determined; spin and parity assignments are presented. Several new isobaric analog pairs in ^{22}Na and ^{22}Ne are also presented. Previous experimental and nuclear structure information is discussed. (5 figures, 3 tables) (auth)

21611 (ORNL-TM-5203) SB2, Experiment on Secondary Gamma-Ray Production Cross Sections Arising from Thermal-Neutron Capture in Each of 14 Different Elements Plus a Stainless Steel. Maerker, R. E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-Eng-26. 36p. (ENDF-227). Dep. NTIS $5.00.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. This particular experiment measured the secondary gamma-ray production cross sections arising from thermal-neutron capture in iron, nitrogen, sodium, aluminum, copper, titanium, calcium, potassium, chlorine, silicon, nickel, zinc, barium, sulfur and a type 321 stainless steel. 1 figure, 30 tables (auth)

21612 (ORNL-TM-5241) CROSS SECTIONS FOR THE Al(n,xn) AND Al(n,x gamma) REACTION BETWEEN 1 AND 20 MeV. Morgan, G. L.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 57p. Dep. NTIS $5.50.

Differential cross sections for the production of secondary neutrons and photons from aluminum have been measured at 127^{0} (lab) for incident neutron energies in the range 1 to 20 MeV. An electron linac was used as a neutron source with a white spectrum. Incident neutron energies were determined using time-of-flight techniques for a source-to-sample distance of 48 m. Secondary spectra were determined by unfolding the pulse-height distributions observed in a NE-213 scintillation counter. The results are compared to the current evaluated data file (ENDF/B-IV, MAT 1193). (auth)

21613 PROTON RADIATIVE CAPTURE BY ^{31}P NUCLEI. Kostin, V. Ya.; Kopanets, E. G.; Koval, A. A.; L'vov, A. N.;

Migalenya, V. Ya.; Tsytko, S. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 11, 1781-1794 (Nov 1975). (In Russian).

The reaction $^{31}P(p,\gamma)^{32}S$ was studied in the range of E_p = 1800 to 8000 keV. The excitation, function γ-ray spectra and angular correlations were measured. The strengths of resonances, decay schemes, quantum characteristics and probabilities of electromagnetic transitions in the ^{32}S nucleus were determined. (auth)

21614 INTERMEDIATE STRUCTURES IN THE SCATTERING OF α-PARTICLES BY ^{28}Si NUCLEI. Kamys, B.; Bobrowska, A.; Budzanowski, A.; Jarczyk, L.; Kapuscik, A.; Wrobel, Z. (Jagelon Univ., Krakow). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 64-73(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 75-86(1975).

The autocorrelation functions for the elastic and two inelastic channels of α- particle scattering by ^{28}Si were calculated. The average width of the compound states was found to equal about 100 keV which is in good agreement with the results obtained by other authors. The form of the autocorrelation function indicates the presence of nonstatistical modulations in the excitation functions. An analysis of the correlation coefficients calculated for all pairs of excitation curves for the elastic and first two inelastic channels indicates the existence of intermediate resonances in all of the reaction channels studied. The nonfluctuational component of the average effective cross section was found for all elastic-scattering angles. (13 figures) (auth)

21615 MANY-PARTICLE–MANY HOLE CONFIGURATIONS AND THE SPECTRUM OF PHOTOPROTONS FROM THE ^{26}Mg NUCLEUS. Varlamov, V. V.; Zhivopistsev, F. A.; Ishkhanov, B. S.; Lukashev, A. V. (Scientific-Research Inst. of Nuclear Physics, Moscow). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 113-115(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 131-133(1975).

By means of bremsstrahlung having a maximum energy E_γ^{max} = 32.0 MeV the betatron at the Scientific-Research Institute of Nuclear Physics, Moscow State University was used to obtain the spectrum of photoprotons from the ^{26}Mg nucleus. The shape of the obtained photoproton spectrum is analyzed within the framework of the many-particles — many hole configuration model. In the given model the emission of nucleons as a result of the so-called pre-equilibrium decay (i.e., the emission of photonucleons from many-particle — many-hole configurations is taken into account in order to describe the photodisintegration characteristics of atomic nuclei. (2 figures) (auth)

21616 INTERFERENCE EFFECTS IN ELASTIC SCATTERING OF CHARGED PARTICLES. Stryuk, Yu. S.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 163-170(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 184-192(1975).

In analyzing the elastic scattering of charged particles it is necessary to take into account the difference between the Coulomb interaction in the region of the nucleus and Rutherford interaction. It leads to the appearance of additional phase shifts of certain partial waves and in the final analysis to a very pronounced difference between Coulomb scattering and the predicted Rutherford formula. Formally this phenomenon may be explained by interference between the Rutherford amplitude and the correction to this amplitude caused by the spatial distribution of the charge over the volume of the nucleus. In analyzing the angular distributions of the products of nuclear reactions it is important in certain cases to know the behavior of the total elastic-scattering wave function. But the total wave function is the coherent sum of the partial wave functions. This leads to the appearance of interference between the different partial waves, which may exert a substantial effect, for example, on such a quantity as the density of the probability that an incoming particle is situated at a specified point of the nucleus. The example of elastic scattering of α-particles having an energy of 27.2 MeV by an ^{27}Al nucleus is used to consider the cases indicated above of interference in the elastic scattering of charged particles. (5 figures) (auth)

21617 SUPERALLOWED NUCLEAR β-DECAY. Hardy, J. C.; Schmeing, H.; Geiger, J. S.; Graham, R. L.; Towner, I.S. (Nuclear Labs., Chalk River, Ont.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 42-45(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 51-54(1975).

A superallowed β decay between analog 0^+ states is virtually independent of the nuclear structure. The intensity of the transition is determined by the vector coupling constant of nuclear β decay and by the vector matrix element which is affected exclusively by deviations from the exact analog nature of the initial and final states. In practice, however, many of the results of exact measurements of the intensity of transitions between states having T = 1 did not agree with one another. The most probable explanation of the scatter of the data resides in the fact that the effects caused by the charge-dependent forces are not negligibly small. In searches for a method to achieve experimental separation of these effects from other small contributions, the proposition was stated that the difference between the values of ft for two image superallowed transitions belonging to a single multiplet having T = 1 may be a sensitive indicator of the magnitude of the impurity consisting of charge-dependent forces. For this purpose multiplets having A = 26 and A = 34 were selected. The decay chain for a mass A = 34 triplet is displayed along with data on the two multiplets. Results for both correspond to image asymmetry and do not reveal anomalously large charge-dependent impurities. (auth)

21618 HIGHLY INELASTIC SCATTERING OF MEDIUM ENERGY DEUTERONS. Wieman, H. H. Seattle; Univ. of Washington (1975). 219p. University Microfilms Order No. 75-28,462.

Thesis (Ph. D.).

The energy spectra of deuterons emitted by nuclei (^{27}Al, ^{63}Cu, ^{90}Zr, /sup nat/Ta, ^{197}Au, and ^{208}Pb) when bombarded by 45 MeV deuterons have been measured at a number of angles. Measurements have also been made for deuterons emitted from nuclei (^{66}Zn, ^{89}Y, ^{102}Pd and ^{107}Ag) when bombarded by 22 MeV deuterons. Deuterons with a range of energies from the Coulomb barrier of the heavier targets to the elastic energy were detected and identified with dE/dx-E semi-conductor telescopes. Sparse angular distributions and total inelastic cross sections were extracted. The double differential cross sections are forward peaked as a result of predominantly direct inelastic scattering. The total inelastic cross sections have little dependence on target mass. Attempts have been made to explain the smooth spectra in terms of a sum of collective multipole excitations in which the amplitudes have been determined with the help of energy weighted sum rules. The predicted cross sections using this approach qualitatively reproduce a number of features of the data but numerical comparisons are often off as much as a factor of two. (Diss. Abstr. Int., B)

21619 DETERMINATION OF THE DECAY PARAMETERS OF RESONANT STATES. Tsoupas, N. Columbus, OH; Ohio State Univ. (1975). 158p. University Microfilms Order No. 75-19,496.

Thesis (Ph. D.).

The partial decay proton widths and the relative phases of six of the resonances in ^{29}P from excitation energies 5.7 to 7.1 MeV were determined. For this determination the angular distributions of protons scattered inelastically from the first 2^+ excited state in ^{28}Si have been measured at 88 energies between E/sub p/ equals 3.0 to 5.2 MeV. The coefficients describing the angular distributions were extracted from the experimental data and plotted as a function of C.M. bombarding energy over the resonance region. In addition triple angular correlations in the spin-flip geometry of the inelastically scattered protons from the 2^+ first excited state of ^{28}Si with the gamma-rays resulted from the de-excitation of ^{28}Si to its ground state were performed over the energy region E/sub p/ equals 3.0 to 4.7 MeV. The coefficients describing these triple angular correlations were extracted and plotted versus C.M. bombarding energy. To aid in the analysis the experimental data of another triple angular correlation in the Goldfarb-Seyler geometry between the two radiations as in the spin flip angular correlation were used. Further analysis of the experimental data for the extraction of the partial decay widths and phases proceeded by calculating the theoretical expressions of the coefficients versus energy, using a Breit-Wigner formalism including interference between the resonances. The calculated theoretical coefficients were compared with the experimental ones through an on-line interactive program which permitted visual comparisons of the theoretically calculated coefficients to the experimental coefficients. The partial decay proton widths and the relative phases for six of the resonances will be presented in this dissertation. (Diss. Abstr. Int., B)

21620 PHENOMENOLOGICAL EFFECTIVE INTERACTION OF ^{40}K. Prakash, M.; Waghmare, Y. R. (Indian Inst. of Tech., Kanpur). Pramana; 5: No. 5, 239-248(Nov 1975).

Effective interactions of various forms incorporating central, spin-orbit and tensor dependences of two-nucleon potential are parametrized so as to give a satisfactory description of energy levels of ^{40}K. These parameters are applied to calculate energy levels of ^{38}Cl. Except for the lowest 3^- level, the agreement is satisfactory. (6 tables, 1 figure) (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 21581, 21598, 21602, 21605, 21611, 21666, 21721, 21773, and 21855.

21621 (COO-1779-49, pp 177-183) OBSERVATION OF ^{5}M AND ^{6}E TRANSITIONS FROM THE DECAY OF /sup 53m/Fe. Black, J. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

A decay scheme of /sup 53 m/Fe including the newly found 1712.6-keV M5 and 3040.6-keV E6 transitions is proposed. (auth)

21622 (COO-1779-49, pp 184-191) IN-BEAM STUDY OF THE DECAY OF ^{40}Sc TO ^{40}Ca. Black, J. [nd]

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

On-line gamma-ray spectroscopy is used to study the short lived isotopes ^{40}Ca and ^{40}Sc. (BJG)

21623 (COO-1779-49, pp 192-193) SUPERALLOWED DECAY OF THE ANALOG STATE /sup 53m/Co to /sup 53m/Fe. Black, J. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

A search for a gamma decay branch of /sup 53 m/Co is discussed, and evidence for such a decay branch was not found. (BJG)

21624 (COO-1779-49, pp 194-198) SEARCH FOR THREE-PARTICLE ISOMERIC STATES IN ^{43}Ti AND ^{43}Sc. Black, J. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

High-spin, three-particle states analogous to that discovered in ^{53}Fe are looked for in ^{43}Ti and ^{43}Sc. Preliminary experiments limited to activities with half-lives greater than 15 seconds do not support the existence of such states. However, indications are that the half-life of the $^{19}/_{2}^{-}$ state of ^{43}Ti is shorter than one second. The $^{19}/_{2}^{-}$ state in ^{43}Sc is believed to be very similar to the ^{43}Fe case. (BJG)

21625 (COO-1779-49, pp 199-201) (p,n gamma) REACTIONS. Warner, R.; Samuelson, L. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

States in ^{51}Co are examined via the gamma-rays emitted from the products of (p,n) reactions near the threshold for production of each successive excited state. (auth)

21626 (ORNL-TM-5098) Cr(n,x gamma) REACTION CROSS SECTION FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.2 AND 20.0 MeV. Morgan, G. L.; Newman, E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 51p. (ENDF-222). Dep. NTIS $5.50.

Differential cross sections for the neutron-induced gamma-ray production from natural chromium have been measured for incident neutron energies between 0.2 and 20.0 MeV. The Oak Ridge Linear Accelerator (ORELA) was used to provide the neutrons and a NaI spectrometer to detect the gamma rays at the laboratory angle of 125^{0}. The data presented are the double differential cross section, d^{2}sigma/d OMEGA dE, for gamma-ray energies between 0.3 and 10.6 MeV for coarse intervals in incident neutron energy. The integrated yield of gamma rays of energies greater than 300 keV and higher resolution in the neutron energy is also presented. The experimental results are compared with the Evaluated Neutron Data Files (ENDF). 23 figures, cross section tables (auth)

21627 NEUTRON CROSS SECTION OF ^{55}Mn BELOW 240 keV. Mughabghab, S. F. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 661-662(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21628 APPLICATION OF THE SHELL APPROACH TO A DESCRIPTION OF THE DIFFERENTIAL ELASTIC-SCATTERING CROSS SECTIONS AND THE POLARIZATION OF LOW-ENERGY NEUTRONS. Sirotkin, V. K.; Chesnokova, V. D. (Moscow Engineering-Physics Inst.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 91-97(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 105-113(1975).

Computations were performed of the cross sections of interaction with nuclei and the polarization of neutrons for elastic scattering at an energy of 1.5 MeV on nuclei of medium weight. At these energies the main contribution is made by s- and p-waves. It is concluded that consideration of the Fermi occupancy of the one-particle levels of the target nucleus within the framework of the shell model leads to a difference from the results of the optical model. (7 figures) (auth)

21629 TRANSITION PROBABILITIES IN SOME NUCLEI. Gupta, V. P.; Gupta, D. K. (Aligarh Univ., India). Indian J. Pure Appl. Phys.; 13: No. 5, 334-335(May 1975).

Using delayed coincidence technique, the half-life ($T_{\frac{1}{2}}$) of 68-keV state in ^{44}Sc is measured. The experimental values of nuclear lifetimes are taken from earlier published data [Nucl. Phys., A 182 (1972), 669] and experimental M^{1}-, E^{1}- and E2-transition probabilities are calculated. They are compared with the single-particle estimates. In the l-forbidden transitions the experimental transition probabilities are also compared with the predictions of Arima et al. [Prog. theor. Phys., 17 (1957), 667; 12 (1954), 623; Suppl. Prog. theor. Phys., 8 (1958), 47]. (auth)

21630 COMPLETE AND INCOMPLETE FUSION IN HEAVY-ION COLLISIONS. Lefort, M. (Institut de Physique Nucleaire, Orsay, France). Phys. Scr.; 10A: 101-109(1974).

From 20th nobel symposium; Ronneby, Sweden (11 Jun 1974).

This is a survey of the work done at Orsay on the accelerator ALICE, on reactions induced by very heavy ions. (Ar to Kr). It deals mainly with the questions of complete fusion and very inelastic exchanges of nucleons which are relevant to the problem of nuclear viscosity. New results are presented on the very inelastic processes which produce light fragments in Ar-induced reactions on Ni and Th targets. The angular and mass correlation has been verified between the light and the heavy partner, and it is now entirely proven that a large amount of energy is dissipated into intrinsic excitations. Measured cross sections for complete fusion are compiled and a number of comments are given on the limitation for fusion in relation to critical angular momenta and critical distances of approach. For reactions induced by krypton and copper ions, the fusion barrier is higher than the interaction barrier. Below the fusion barrier, peculiar phenomena occur, named "quasi-fission". The fusion barrier is explained in terms of a cut-off in the low lh population for partial waves of the incoming ion, due to friction forces. (2 figures, 1 table) (auth)

21631 TRANSFER REACTIONS ON HEAVY IONS (PECULIARITIES OF TRANSFER REACTIONS FOR DEEPLY INELASTIC COLLISIONS BETWEEN TWO NUCLEI). Artyukh, A. G.; Volkov, V. V.; Gridnev, G. F.; Mikheev, V. L. Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 1-17(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 2-23(1975).

The experimental material presented and the analysis which has been performed allow the conclusion to be drawn that in transfer reactions involving deeply inelastic collisions between two complex nuclei, a fundamentally new mechanism of nuclear reactions unknown for light bombarding particles was realized. The characteristic feature of this mechanism is the formation of a binary nuclear system in which the nuclei preserve their individuality to a considerable degree in spite of intense interaction. These reactions simultaneously combine features inherent in classical direct processes and a compound nucleus. (13 figures, 2 tables) (auth)

21632 MEASUREMENT OF THE POLARIZATION OF NEUTRONS FROM (p,n) REACTIONS AT ISOBARIC ANALOG RESONANCES. Sexton, E. H. Albany; State Univ. of New York (1975). 138p. University Microfilms Order No. 75-28,896.

Thesis (Ph. D.).

Measurements were made of the polarization of neutrons from the ^{51}V(p,n)^{51}Cr and ^{55}Mn(p,n)^{55}Fe reactions at proton energies corresponding to isobaric analogue resonances. For the first reaction in the vicinity of the IAR at E/sub p/ equals 2.335 MeV the polarization excitation function (lab angle of 50^{0}) was similar in shape to the yield curve; the maximum value of P was +12 percent and occurred at the resonance energy. Polarization values ranged between −6 percent and +12 percent for several scattering angles and proton energies. The ^{55}Mn(p,n)^{55}Fe results indicate small non-zero values of neutron polarization for nearly all values of E/sub p/, and with the variation of polarization with energy and scattering angle being generally structureless. The R-matrix theory of nuclear reactions was used with certain simplifying assumptions to describe the energy behavior, angular distributions, and polarizations in the vicinity of the 2.335 MeV IAR of the ^{51}V(p,n)^{51}Cr reaction. The model was able to fit the yield curve, but only partially successful in describing the variation of polarization with energy across the resonance. A study is made of the conditions on the scattering matrix ele-

ments for a number of choices of J/sup pi/ for the 2.335 MeV resonance and the less prominent nearby 2.345 MeV resonance. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 21581, 21598, 21605, 21611, 21618, 21628, 21630, 21638–21642, 21700, and 21773.

21633 (CONF-7309135-, pp 209-251) EXPLORING THE NUCLEAR CONTINUUM BY THE CRYSTAL BLOCKING TECHNIQUE. Temmer, G. M. (Rutgers–the State Univ., New Brunswick, NJ). 1973.

From international summer school on boundary problems between nuclear and solid state physics; Predeal, Romania (6 Sep 1973).

In frontier problems on nuclear and solid state physics.

Various blocking lifetime experiments for the exploration of the nuclear continuum are discussed. Various intermediate-mass nuclei are discussed. (JFP)

21634 (COO-1779-49, pp 163-167) DECAY OF ^{63}Zn. Geisler, G. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Coincidence and anticoincidence experiments are used to study the decay of ^{63}Zn. A decay scheme is given. (BJG)

21635 (COO-1779-49, pp 168-171) DECAY OF ^{62}Zn. Geisler, G. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Higher energy transitions in ^{62}Zn decay are examined. Two new gamma-rays at 1142.5 keV and 1389.3 keV are reported. (BJG)

21636 (COO-1779-49, pp 174-176) ^{62}Ga AND beta-DELAYED alpha EMISSION. Geisler, G.; Kosanke, K. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The possible existence of delayed alpha emission in the light gallium isotopes is studied. (auth)

21637 (LYCEN-7502, pp S.3.1-S.3.14) MECHANISM OF TRANSFER REACTIONS OF ONE AND TWO PROTONS INDUCED BY ^{16}O AND ^{12}C. Cobern, M.; Lemaire, M. C.; Mermaz, M. C.; Sztark, H. (CEN, Saclay, France). 1975. (In French)

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

The experimental results obtained on the angular distributions of elastic and inelastic scattering and one- and two-proton transfer reactions induced by ^{16}O and ^{12}C on target nuclei of ^{64}Ni, ^{72,74,76}Ge, and ^{100}Mo are presented. The ^{64}Ni(^{16}O, ^{15}N)^{65}Cu and ^{64}Ni(^{16}O, ^{14}C)^{66}Zn reactions were subjected to a DWBA analysis. The coupled equation analysis of the two-nucleon transfer showed that the DWBA formalism does not reproduce the form of the experimental angular distribution of the 2^+ level at 0.613 MeV. (JSR)

21638 NUCLEAR DATA SHEETS FOR A equals 60. Kim, H. J. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 16: No. 3, 317-349(Nov 1975).

Experimental nuclear structure information available through May 1975 are compiled, and adopted properties are presented. Following the newly adopted procedure for presenting the information (see Nuclear Data Sheets for A equals 75, Volume 16, Number 1, September 1975), results are directly produced from the Evaluated Nuclear Structure Data File (ENSDF). The present compilation represents an update of the previous work by S. Raman (Nuclear Data B2-5-41, 1968), cited as 68Ra36. Where possible, the data are presented in comparative level diagrams, thereby eliminating many tabular listings. Also, where no additional data which supersede or significantly modify the previous compilation have appeared since, only the values adopted from the latter are presented. (auth)

21639 NUCLEAR DATA SHEETS FOR A equals 65. Auble, R. L. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 16: No. 3, 351-382(Nov 1975).

Nuclear structure data available through July 1975 are compiled, and adopted level properties are given. The bulk of the data are presented pictorially for easy comparison. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the compilers for maintenance and updating of the computer file. (auth)

21640 NUCLEAR DATA SHEETS FOR A equals 66. Auble, R. L. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 16: No. 3, 383-416(Nov 1975).

Nuclear structure data available through July 1975 are compiled, and adopted level properties are given. The bulk of the data are presented pictorially for easy comparison. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the compilers for maintenance and updating of the computer file. (auth)

21641 NUCLEAR DATA SHEETS FOR A equals 67. Auble, R. L. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 16: No. 3, 417-444(Nov 1975).

Nuclear structure data available through July 1975 are compiled, and adopted level properties are given. The bulk of the data are presented pictorially for easy comparison. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the compilers for maintenance and updating of the computer file. (auth)

21642 NUCLEAR DATA SHEETS FOR A equals 89. Kocher, D. C. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 16: No. 3, 445-505(Nov 1975).

The 1961 version of Nuclear Data Sheets for A equals 89 and the 1970 Midstream Evaluation, A equals 89 [M. W. Johns, J. Y. Park, S. M. Shafroth, D. M. Van Patter, and K. Way, Nuclear Data Tables 8, 373 (1970)], have been revised on the basis of experimental data received prior to August 1, 1975. Results from approximately 150 papers and communications chosen from the extensive literature for this A-chain have been included in the present evaluation. Numerous additional references dealing with reaction mechanism studies and nuclear structure theory are not included in this compilation, but are available upon request from the Nuclear Data Project. Data on nine A equals 89 nuclei are presented. Only the half-lives for ^{85}Se and ^{85}Br have been determined. The decay schemes for ^{85}Kr and ^{85}Rb appear to be well established. The decay scheme for ^{85}Sr is particularly simple, but the intensity for the single gamma-ray in the decay is not well known. Many spin assignments have been made for levels in ^{85}Sr, ^{85}Y, and ^{85}Zr from a variety of decay and reaction studies. The decay schemes for low-spin and high-spin isomers in both ^{85}Zr and ^{85}Nb appear to be well established, but the energy ordering of the two isomers in ^{85}Nb is not known. On the basis of recent results, it appears that the previously claimed isotope ^{85}Mo has not yet been observed.

21643 STUDY OF RESONANCES IN THE ^{58}Ni(p,γ)^{59}Cu REACTION BELOW 2.15 MeV. Din, G. U. (Australian National Univ., Canberra); Al-Naser, A. M. Aust. J. Phys.; 28: No. 5, 503-521(Oct 1975).

The γ-ray spectra for seven resonances in the reaction ^{58}Ni(p,γ)^{59}Cu in the range E_p = 1400-2150 keV have been measured with a high resolution Ge(Li) detector. Consistent resonance decay schemes have been derived along with the decay schemes of bound levels. Decays to previously unreported bound levels at 2.459, 2.711 and 3.025 MeV have been observed, while results significantly different from the earlier reports have been obtained for the decay of most of the bound levels. The reported level at 1.865 MeV is confirmed. The decay schemes of the two resonances at E_p = 1424 and 1844 keV indicate that these are $T = 3/2$ analogue states associated with the levels at 0.880 and 1.301 MeV in ^{59}Ni. A new value of Q = 3.415 ± 0.003 MeV for the reaction ^{58}Ni(p,γ)^{59}Cu was derived from the Ge(Li) spectra. (auth)

21644 CROSS SECTIONS OF PHOTONEUTRON REACTIONS ON ^{64,66,68}Zn, ^{70,72,74,76}Ge, ^{76,78,80,82}Se NUCLEI. Goryachev, A.M.; Zalesnyi, G. N.; Tulupov, B. A. (Saratov State Univ., USSR). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 116-119(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 134-138(1975).

The yield curves for the photoneutron reactions on enriched Zn, Ge, Se samples were measured in the energy range from 9 to 24.8 MeV with a step of 0.2 MeV. The statistical error of the

final neutron yield curve amounted to 0.15% in the E_γ = 24 MeV region. The yield curves obtained after preliminary handling were used to calculate the cross sections of the photoneutron reactions. The cross sections calculated from the yield curves by the Penfold-Leiss method with a step of 1 MeV are tabulated. (3 tables, 3 figures) (auth)

21645 ANALYSIS OF THE CONTRIBUTION OF ELASTIC SCATTERING VIA A COMPOUND NUCLEUS FOR ^{59}Co, ^{58,60,62,64}Ni NUCLEI AT E_p APPROXIMATELY 6 MeV. Gulamov, I. P.; Kalacheva, Z. F.; Omar, M. R.; Romanovskii, E. A.; Spasskaya, T. I.; Gubin, V. B. (Moscow State Univ.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 120-124(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 139-143(1975).

Proton scattering by ^{59}Co and $^{58-64}$Ni nuclei was investigated. The experiments were carried out on the 120-cm cyclotron of the Scientific-Research Institute of Nuclear Physics at Moscow State University. Data on the polarization accompanying elastic scattering for ^{59}Co, ^{58}Ni and ^{60}Ni for $E_p < 6$ MeV were obtained by the method of thick targets. The energy dependences of the polarization for elastic scattering of protons by ^{59}Co nuclei at scattering angles 50-160° and $5 < E_p < 6$ MeV are displayed. (4 tables, 5 figures) (auth)

21646 ELASTIC AND INELASTIC SCATTERING OF α-PARTICLES HAVING AN ENERGY OF 27.2 MeV BY NICKEL ISOTOPES. Alekseev, V. V.; Nemets, O. F.; Stryuk, Yu. S.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 105-112(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 123-130(1975).

The present paper is a continuation of papers investigating elastic and inelastic scattering of α-particles having an energy of 27.2 MeV on even isotopes having masses in the titanium-zinc region. Results are presented of measurements of the differential cross sections for elastic and inelastic scattering of α-particles by ^{62,64}Ni, as well as refined data on the scattering of α-particles by ^{58,60}Ni. The measurements were carried out over a wide range of scattering angles (15 to 175°) with an angular interval of (1 to 3°). (5 figures, 2 tables) (auth)

21647 ISOBARIC ANALOG RESONANCES IN ^{89}Y. Haynes, C. F. New Brunswick, NJ; Rutgers-the State Univ. (1975). 109p. University Microfilms Order No. 75-24,694.

Thesis (Ph. D.).

Polarized beams can increase the sensitivity of proton inelastic scattering measurements to reaction channel interference. A number of isobaric analog resonances in proton scattering from ^{89}Sr strongly excite the 2_1^+ state of ^{88}Sr through the compound nucleus ^{89}Y. The theoretical calculations which have explained the positions of several analog resonances in ^{89}Y require the inclusion of the 2_1^+ state of ^{88}Sr in a weak-coupling calculation of the ^{89}Sr levels. The amplitudes of the weak-coupling terms can be used to describe the interference effects of the outgoing channels of the inelastic reaction. Three resonances at the proton energies 7.0, 7.08, and 7.53 MeV on the target ^{88}Sr were chosen to investigate the possibility of determining the amplitudes experimentally. The corresponding ^{89}Sr levels under investigation were 1.93 MeV ($\frac{5}{2}^+$), 2.00 MeV ($\frac{3}{2}^+$), and 2.46 MeV ($\frac{3}{2}^+$). Angular distributions were measured on resonance at 7.0, 7.08, and 7.53 MeV from proton inelastic scattering to the 1.84 MeV (2^+) state of ^{88}Sr for differential cross section, analyzing power, spin-flip probability, and spin-flip asymmetry. A polarized beam of protons was used to obtain the analyzing power. The spin-flip probability was obtained from the coincidence of the prompt gamma rays from the (p,p'gamma) reaction with the scattered protons. With the polarized beam, the gamma coincidence technique was further used to obtain a spin-flip asymmetry measurement. From these measurements, the polarization was calculated, and the first clear experimental examples of the difference between polarization and analyzing power were found. The inelastic decay widths were fitted to the data, keeping other parameters fixed at various values from previous experiments. A direct reaction background from the first-order distorted-wave Born approximation for the collective excitation of ^{88}Sr was summed into the Breit-Wigner terms of the S-matrix, and it was found to be necessary for good chi^2 values. A comparison of all the amplitudes derived from the decay widths to the theoretical weak-coupling amplitudes for the 1.93, 2.00, and 2.46 MeV levels of ^{89}Sr showed close correspondence, using the $3s\frac{1}{2}$, $2d\frac{3}{2}$, and $2d\frac{5}{2}$ states from the shell model. The signs of the $3s\frac{1}{2}$ amplitude for all three levels were consistently opposite. Except for this feature, all the larger amplitudes were nearly in agreement. (Diss. Abstr. Int., B)

21648 NUCLEAR STRUCTURE INFORMATION FOR STATES IN KRYPTON-85 FROM THE ^{84}Kr(d,p) AND ^{84}Kr(d(pol),p) REACTIONS. Detorie, N. A. III. Notre Dame, IN; Univ. of Notre Dame (1975). 205p. University Microfilms Order No. 75-27,767.

Thesis (Ph. D.).

The (d,p) stripping reaction using polarized and unpolarized deuterons on an isotopically enriched, gas target, ^{84}Kr(J/sup pi/ equals 0^+) was used to gain spectroscopic information for levels in ^{85}Kr. Accurate and precise excitation energies for 41 levels from the ground state to over 4 MeV excitation in ^{85}Kr were measured using nuclear track plates in the Notre Dame 100-cm Modified Broad Range Magnetic Spectrograph. The overall resolution was 16 keV (FWHM). Many of the levels were not reported previously. Typically, the error in the excitation energies was 3 keV or less. At 12 MeV deuteron bombarding energy, a DWBA analysis of the angular distributions enabled l values to be assigned to 29 levels in ^{85}Kr. Measurements of the vector analyzing power enabled j values to be assigned to nine of the ^{85}Kr states. Spectroscopic factors were also extracted. The proton spectra also contained several states in ^{87}Kr as a result of the ^{86}Kr(d,p) reaction. Vector analyzing power measurements of the ^{86}Kr (d(pol)p_0) reaction enabled the first definitive spin assignment of $\frac{5}{2}^+$ to be made to the ^{87}Kr ground state. (Diss. Abstr. Int., B)

21649 ^{70,72,74,76}Ge(d,p)^{71,73,75,77}Ge REACTIONS USING POLARIZED DEUTERONS. Yoh, J.W.A. Notre Dame, IN; Univ. of Notre Dame (1975). 164p. University Microfilms Order No. 75-19,964.

Thesis (Ph. D.).

Differential cross sections and vector analyzing powers were measured at an incident deuteron energy of 12.0 MeV for the ^{70,72,74,76}Ge(d,p)^{71,73,75,77}Ge reactions. The data were compared with the predictions of the Distorted-Wave Born Approximation. From the observed j-dependence exhibited in the angular distributions of vector analyzing power, it has been possible to make spin and parity assignments from a comparison between the data and DWBA predictions. Definitive spin and parity assignments were made to 12 states in ^{71}Ge, 18 states in ^{73}Ge, 13 states in ^{75}Ge and 11 states in ^{77}Ge. Among the 54 states studied in this work, there are 7 $2P^3/_2$ states, 1 $1F^5/_2$ state, 8 $2P^1/_2$ states, 5 $1G^9/_2$ states, 19 $2D^5/_2$ states, 1 $1G^7/_2$ state, 9 $3S^1/_2$ states and 4 $2D^3/_2$ states. Nineteen of these states had not been assigned, or had been assigned incorrectly in previous investigations. For each state studied, the spectroscopic factor was obtained and a simple sum rule analysis was applied to the data. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 20305, 21581, 21598, 21603, 21611, 21618, 21630, 21637, 21697, 21700, 21721, 21751, and 22481.

21650 (COO-1779-49) NUCLEAR CHEMISTRY RESEARCH AT MICHIGAN STATE UNIVERSITY. Annual Report for Calendar Year 1970. McHarris, W. C.; Bernthal, F. M. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). [nd]. Contract AT(11-1)-1779. 316p. Dep. NTIS $10.75.

Separate abstracts were prepared for 31 papers dealing with nuclear structure data. Brief summaries of experimental techniques and instrumentation and environmental studies are included in the report but were not abstracted separately. (CES)

For abstracts of individual papers see: 21621–21625, 21634–21636, 21651–21659, 21671–21673, 21685–21693, 21699, and 21753.

21651 (COO-1779-49, pp 69-73) DECAY OF /sup 145m/Gd. Eppley, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Decay properties of /sup 145m/Gd are studied and a decay scheme is presented. (BJG)

21652 (COO-1779-49, pp 74-82) ESPECIAL CASE OF /sup 145g/Gd. Eppley, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The ground state decay of ^{145}Gd is studied and a decay scheme is presented. (BJG)

21653 (COO-1779-49, pp 83-93) POPULATION OF A THREE-QUASIPARTICLE MULTIPLET IN ^{141}Pm BY THE DECAY OF /sup 141m/Sm. Eppley, R.; Todd, R.; Warner, R. [nd].

In nuclear chemistry research at Michigan State University.

Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

/sup 141m/Sm appears to depopulate by six beta transitions which could be allowed. These states which de-excite predominately through the 628.6-keV state which has been identified as the h/sub 11/2/, are discussed in light of what is known about three-quasiparticle states. (auth)

21654 (COO-1779-49, pp 94-101) PREPARATION AND DECAY OF /sup 141g/Sm. Eppley, R.; Todd, R.; Warner, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Gamma rays constituting transitions resulting from the decay of /sup 141g/Sm are studied. Problems involving the intense 438.2-keV peak are discussed. (BJG)

21655 (COO-1779-49, pp 102-115) ATTEMPTS TO PREPARE ^{147}Cy AND SOME OBSERVATIONS ON THE LIMITS TO PRODUCTION OF NUCLEI FARTHER FROM STABILITY. Eppley, R.; Warner, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Gamma-ray and x-ray spectra are taken in an attempt to infer production of /sup 147m/Dy from its epsilon/beta$^+$ decay. Problems related to the production of extremely neutron deficient nuclei are discussed. (auth)

21656 (COO-1779-49, pp 116-117) BETA $^+$/ELECTRON CAPTURE DECAY OF ^{143}Sm. Firestone, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The study of ^{143}Sm decay is of considerable interest in light of previous work on its N equals 81 isobars ^{141}Nd and ^{141}Gd. All three isobars have 11/2 metastable states at 720-756 keV with 60-85 second half-lives. The ^{143}Sm and ^{145}Gd metastable states are found to have a small beta branch to states in the respective daughter nuclei. (auth)

21657 (COO-1779-49, pp 136-148) (p,t) REACTION ON ^{141}Pr. Goles, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The (p,t) reaction on ^{141}Pr is studied in order to determine the general systematics of the (p,t) reaction in the rare earth region. The residual nucleus of this reaction ^{139}Pr is studied through the epsilon/beta$^+$ decay of the ground and metastable states of ^{139}Nd. (auth)

21658 (COO-1779-49, pp 149-162) (p,t) REACTION ON DEFORMED RARE-EARTH NUCLEI. Goles, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

In an attempt to characterize the general systematics of the (p,t) reaction in the rare earth region of the periodic table, the (p,t) reaction on ^{141}Pr, ^{159}Tb, ^{165}Ho, and ^{169}Tm are investigated. (auth)

21659 (COO-1779-49, pp 217-220) DETERMINATION OF OCCUPATION NUMBERS BY BETA DECAY IN NUCLEI BELOW N equals 82. McHarris, W.; Eppley, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Decays of the (nu h/sub 11/2)$^{-1}$ isomeric states, /sup 141 m/Nd, /sup 143 m/Sm, and /sup 145 m/Gd, and their direct beta$^-$/epsilon decay to the pi h/sub 11/2/ states in their respective daughters are studied. (auth)

21660 (IS-T-707) GAMMA-RAY DECAY SCHEMES FOR ^{93}Kr, ^{93}Rb, AND ^{93}Sr. Bischof, C. J. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 158p. Dep. NTIS $6.00.

Thesis.

A study of the gamma-ray de-excitation following the beta decays of ^{93}Kr, ^{93}Rb, and ^{93}Sr using the TRISTAN on-line separator facility is reported. Gamma-ray singles and gamma-gamma coincidence measurements were made using Ge(Li) detectors. Of the 162 gamma rays observed in the decay of ^{93}Sr, 143, representing more than 99 percent of the total gamma-ray intensity observed, were placed in a level scheme containing 36 levels. For the decay of ^{93}Rb, 243 gamma rays were observed, of which 231 are placed in a level scheme consisting of 74 levels. This again represents a placement of over 99 percent of the total gamma-ray intensity measured. In the case of the ^{93}Kr decay approximately 98.5 percent of the observed gamma-ray intensity has been accounted for by the proposed level scheme. This results from the placement of 203 of the 217 gamma rays assigned to this decay in a level scheme comprising 56 levels. Beta-branching for these decays were determined from transition intensity balances. Spin and parity assignments were proposed, whenever possible, on the basis of gamma-ray transition probabilities and deduced log ft values. A comparison is made with the available reaction data for the ^{93}Y level scheme. In all cases an attempt has been made to explain some of the levels in terms of the nuclear shell model and decay systematics. 18 figures, 20 tables, 68 references. (auth)

21661 NUCLEAR DATA SHEETS FOR A equals 120. Kocher, D. C. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 17: No. 1, 39-95(Jan 1976).

The 1960 version of Nuclear Data Sheets for A equals 120 has been revised on the basis of experimental data received prior to September 1, 1975. Results from approximately 130 papers and communications have been included in the present evaluation. Data on ten A equals 120 nuclei are presented. Two beta-decaying isomers are known for each of the odd-odd nuclei ^{120}Ag, ^{120}In, ^{120}Sb, and ^{120}I. Only for ^{120}Ag is the energy ordering of the two isomers known, and only for ^{120}In and ^{120}Sb are the decay schemes for the two isomers well determined. With the exception of ^{120}I, other excited levels in these odd-odd nuclei have not been identified. Reaction studies to determine excited levels in ^{120}Sb would seem particularly appropriate. Other than a half-life, little is known about the remaining odd-odd nucleus, ^{120}Cd. For the even-even nuclei, the decay scheme for ^{120}Cd is somewhat uncertain, although it is likely that most of the decay directly feeds the 1$^+$ isomer in ^{120}In. Many levels in stable ^{120}Sn and ^{120}Te are known from a variety of decay and reaction studies. The complex decay scheme for ^{120}Xe appears well determined, but little is known about ^{120}Ba decay. A few excited levels for ^{120}Xe and ^{120}Ba comprising rotational bands have been proposed from in-beam gamma-ray spectroscopy. (auth)

21662 NUCLEAR DATA SHEETS FOR A equals 118. Carlson, G. H. (Ames Lab., IA); Talbert, W. L. Jr.; Raman, S. (Ames Lab., IA). Nucl. Data Sheets; 17: No. 1, 1-37(Jan 1976).

The 1960 version of the Nuclear Data Sheets for A equals 118 has been revised on the basis of experimental data received before September 1973, with some later modifications. Experimental data concerning the nuclear structure of ten isotopes were compiled and used in the construction of the level schemes and J/sup pi/-assignments. (auth)

21663 EXCITATION FUNCTIONS OF (pn)- AND (p,2n)-REACTIONS OF CADMIUM ISOTOPES. Skakun, E. A.; Klyucharev, A. P.; Rakivnenko, Yu. N.; Romanii, I. A. (Physical-Technical Inst., Kiev). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 18-23(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 24-30(1975).

Excitation functions of reactions of the type (p,n) and (p,2n) on $^{110-114}$Cd and ^{114}Cd were investigated in the range of bombarding proton energies up to 20 MeV. Theoretical calculations were made using the Weisskopf-Ewing formula and the statistical theory of nuclear reactions. (3 tables, 3 figures) (SDF)

21664 RELATIVE CROSS SECTIONS OF THE FORMATION OF INDIUM ISOMERS IN (pn)- AND (p,2n)-REACTIONS ON CADMIUM ISOTOPES. Skakun, E. A.; Klyucharev, A. P.; Rakivnenko, Yu. N.; Romanii, I. A. (Physical-Technical Inst., Kiev). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 24-29(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 31-36(1975).

The relative cross sections of the formation of the indium isomers ^{109*g}In, ^{110*g}In, and ^{112*g}In in reactions with protons having energies up to 20 MeV are analyzed. The interaction of protons with nuclei at energies above approximately 10 MeV is noteworthy in that besides reactions of the (p,n) type new channels such as (p,2n) and (p,pn) open up here. Along with the investigation of the excitation functions, an analysis of the relative cross sections of the formation of isomer pairs is a means for testing the statistical theory. (5 figures, 2 tables) (auth)

21665 VALUES OF THE LIFETIMES OF STATES HAVING A HIGH NUCLEAR SPIN FOR WHICH BACK BENDING IS OBSERVED. The Possibility of Measuring g-Factors by the Method of Varying the Flight of Recoil Nuclei in Vacuum. Ward, D.; Andrews, H. R.; Costa, G. J.; Geiger, J. S.; Graham, R. L.; Taras, P. (Nuclear Labs., Chalk River, Ont.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 30-35(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 37-43(1975).

A description is given of a method for obtaining g factors of high spin states using lifetime data from the reactions ^{110}Pd(^{24}mg,4n)^{130}Ce at 103 MeV and ^{115}In(^{19}F,4n)^{130}Ce at 86 MeV. (5 figures, 2 tables) (SDF)

21666 G_4-G_2 PARAMETRIC PLOTS IN PERTURBED ANGULAR CORRELATIONS. Banerjee, S. (State Univ. of New York, Stony Brook); Blume, M. Hyperfine Interact.; 1: 177-181 (1975).

Time-integrated attenuation factors for pure magnetic dipole, pure electric quadrupole, and mixed hyperfine interactions were calculated for a wide range of correlation time by using the Scherer–Blume model. It is shown that conclusions drawn from the G_4-G_2 parametric plots as to the type of interaction present are subject to serious uncertainties. (3 figures) (auth)

21667 ANOMALOUS STATES OF ODD SPHERICAL NUCLEI. Mitroshin, V. E. (Inst. of Nuclear Physics, Leningrad). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 80-90(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 93-104(1975).

Based on the approach developed an analysis was performed of the excitation spectra of the ^{95,97,99}Tc isotopes. Calculations showed that one can satisfactorily describe: the energetics of the excitation spectrum, the approximate equality of the g-factors of the states having $J^\pi = 5/2^+, 7/2^+, 9/2^+$ of the Tc isotopes, and, depending on the magnitude of g_R, the probabilities of the M1-transitions. The probabilities of E2-transitions are described well, besides the strong quadrupole transition $5/2 \rightarrow 1/2$ which is caused by a significant two-phonon excitation impurity in the one-phonon $5/2^+$-state. A satisfactory description of the probabilities of the β^+-transitions ^{95,97}Ru $\rightarrow$ ^{95,97}Tc was obtained, as well as a qualitative explanation of the results of the stripping reaction. The analysis of the experimental data in the $18 < A < 150$ range indicates the extremely important role of an odd quasiparticle in the formation of vibrational states. This leads to pronounced distortion of the excitation spectrum, which is often ascribed either to the appearance of deformation or to distortions in the shell structure. (5 figures, 8 tables) (auth)

21668 GAMMA-RAY INTENSITIES FOR THE RADIOACTIVE DECAY OF ^{140}Ba AND ^{140}La. Harvey, J. T. (Univ. of Arkansas, Fayetteville); Meason, J. L.; Hogan, J. C.; Wright, H. L. Nucl. Sci. Eng.; 58: No. 4, 431-435(Dec 1975).

Gamma-ray spectra from the radioactive decay of ^{140}Ba and ^{140}La were observed by Ge(Li) spectroscopy. Gamma-ray energies were found to be consistent with literature values, but several of the observed gamma rays were found to have intensities differing significantly from those previously reported. Absolute intensities of prominent gamma rays emitted in the radioactive decay of ^{140}Ba and ^{140}La have been measured. The 12.8-day ^{140}Ba activity was produced by 14.8-MeV neutron fission of ^{238}U followed by radiochemical separation and purification. 3 tables. (auth)

21669 COMMENTS ON PHYSICAL CHARACTERISTICS OF ^{99m}Tc: CALCULATION OF E-BAR$_\beta$ GAMMA, Δ_i. Leblanc, A. D. (Baylor Univ., Houston, TX); Noz, M. E.; Maquire, C. Q. Jr. Int. J. Appl. Radiat. Isot.; 26: No. 12, 785-786(1975).

Two separate letters refer to a recent technical note by Rajput and Dubey (Int. J. Appl. Radiat. Isotopes.; 26: 35 (1975)) concerning the physical characteristics of ^{99m}Tc and point out that values of $\bar{E}_\beta$, Γ and Δ_i given therein are incorrect. It is also claimed that the impression given in the original note that ^{99m}Tc is the preferred isotope for thyroid and placental studies is incorrect as its use is not yet perfected. (UK)

21670 DETERMINATION OF THE HALF-LIFE OF ^{103}Pd. Czock, K. H.; Haselberger, N.; Reichel, F.; Popa, S. (International Atomic Energy Agency, Vienna). Int. J. Appl. Radiat. Isot.; 26: No. 12, 782-784(1975).

Measurement of the half-life of ^{103}Pd, using a 0.5 cm^3 Ge(Li) detector, a 2 mm thin NaI(Tl) crystal and a 4π-proportional flow counter is reported. Sources of high radiochemical purity prepared from Pd powders of various origins were used. The final result for the half-life is (16.961 ± 0.016) days. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 21618, 21630, 21658, 21751, and 21759.

21671 (COO-1779-49, pp 118-135) ROTATIONAL BANDS IN ^{167}Tm EXCITED BY THE DECAY OF ^{167}Yb. Goles, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The existence of twelve new excited states and the probable placement of a thirteenth in the daughter nucleus ^{167}Tn is established. These thirteen states together with the well established level structure below 300 keV of excitation in the ^{167}Tn nucleus form a consistent framework for the placement of 52 new gamma-rays associated with the decay of ^{167}Yb. (auth)

21672 (COO-1779-49, pp 202-203) (alpha,xn) AND (^{3}He,xn) IN-BEAM gamma-RAY SPECTROSCOPY STUDIES IN THE RARE-EARTH REGION. Bernthal, F.; Warner, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Preliminary runs have been carried out attempting to use oxide targets to study prompt gamma-ray spectra of odd-A deformed nuclei in the rare-earth region. Further experiments on the N equals 105 ^{179}W system will be carried out with a separated isotope ^{177}Hf metallic target. Plans are also underway to study the in-beam gamma-ray spectra of ^{181}W, ^{181}Os, and ^{183}Os. (auth)

21673 (COO-1779-49, pp 224-225) K equals O^+ EXCITED STATES IN DEFORMED EVEN-EVEN NUCLEI. Bernthal, F. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Multiple low-energy O^+ excitations in ^{176}Hf and ^{170}Yb are discussed. An experimental program of (^{3}He,t) and (^{3}He,d) reaction studies is being designed to complement the theoretical work. (auth)

21674 (JINR-P4-9196) SHELL ENERGIES OF RAPIDLY ROTATING NUCLEI. Specific Features of the Yrast-Cascade and the Upper Spin Limit. Neergard, K.; Pashkevich, V. V.; Frauendorf, S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 26p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The deformation energies of 18 rapidly rotating rare earth nuclei with spins up to the limit of stability against centrifugal fission are considered within the framework of the earlier proposed model. The implications of the calculated energy landscape for the properties of the yrast γ-decay are discussed. (1 table, 3 figures) (auth)

21675 (LYCEN-7502, pp S.7.1-S.7.5) INTEREST OF (p,t) REACTIONS FOR THE STUDY OF THE STRUCTURE OF HEAVY NUCLEI WITH ODD Z. Seltz, R.; Sharma, H. L. (Univ. of Minnesota, Minneapolis). 1975. (In French)

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

Experimental results of the angular distributions of (p,t) reactions at 19 MeV incident energy were reported for the following targets: ^{181}Ta ($7/2^+$), ^{197}Au ($3/2^+$), ^{203}Tl ($1/2^+$), and ^{205}Tl ($1/2^+$). The form of the angular distribution curves made it possible to determine the spins of the final nuclei in the case of transfers $L = 0$. The case of $L \neq 0$ is briefly discussed to illustrate the data that can be derived. (JSR)

21676 NUCLEAR DATA SHEETS FOR A equals 167. Harmatz, B. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 17: No. 1, 143-192(Jan 1976).

The literature on all nuclei with mass number A equals 167 has been reviewed, and the nuclear structure information is summarized here. The level properties obtained from various reaction and decay experiments are shown in the drawings, and Nilsson-state assignments are given. (auth)

21677 NUCLEAR DATA SHEETS FOR A equals 162. Buyrn, A. (Massachusetts Inst. of Tech., Cambridge). Nucl. Data Sheets; 17: No. 1, 97-142(Jan 1976).

Nuclear structure data for mass 162 nuclei are compiled, and adopted level and gamma-ray properties are presented. The adopted values are based on all data received before May 1974. All published data received between May and August 1974 have also been considered in arriving at adopted values. (auth)

21678 E2,M1 MULTIPOLE MIXING RATIOS IN EVEN-EVEN NUCLEI, A GREATER THAN OR EQUAL TO 152. Krane, K. S. (Oregon State Univ., Corvallis). At. Data Nucl. Data Tables; 16: No. 4, 383-408(Oct 1975).

A survey is presented of E2,M1 mixing ratios of gamma-ray transitions in even-even nuclei with mass numbers A greater than or equal to 152. Angular distribution and correlation data from the literature are analyzed in terms of a consistent choice of the phase relationship between the E2 and M1 matrix elements. The cutoff

date for the literature was June 1975. Based on an average of the experimental results from the literature, a recommended value of the E2,M1 mixing ratio for each transition is included. (auth)

21679 NEUTRON-INDUCED DOSE ENHANCEMENT IN TANTALUM. Lurie, N. A.; Harris, L. Jr.; Steinman, D. K.; Young, J. C.; Friesenhahn, S. J.; Wondra, J. P. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2573-2575(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Local dose enhancement caused by neutron capture in tantalum devices has been predicted but not previously measured. An experiment is reported in which the dose due to conversion electrons and sub-MeV photons resulting from neutron capture in Ta is compared to the dose from high-energy photons. For measurements on a thin Ta foil using a silicon surface barrier detector and incident neutrons in the resonance region (thermal to 500 eV), the dose enhancement ratio (dose due to all secondary radiations/dose due to super-MeV photons) was found to be 4.7 +- 0.3. 1 table, 5 figures. (auth)

21680 IMPROVING THE METHOD OF USING DOPPLER BROADENING OF A LINE IN ORDER TO MEASURE THE LIFETIMES OF STATES HAVING HIGH SPINS IN NUCLEI IN THE RARE-EARTH REGION. Ward, D.; Andrews, H. R.; Graham, R. L.; Geiger, J. S.; Sie, S. H. (Nuclear Labs., Chalk River, Ont.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 36-41(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 44-50(1975).

Thick ^{152}Sm, ^{154}Gd and ^{156}Gd targets were bombarded with ^{35}Cl ions having an energy of 130 to 135 MeV. In these nuclei, excited states were observed right up to the 12^+ level, however the 10^+ state had the highest spin whose lifetime could be determined with statistical significance. Lifetimes were determined using an improved Doppler broading method. (7 figures, 2 tables) (auth)

21681 MEASUREMENT OF THE PERTURBED ANGULAR $\gamma\gamma$-CORRELATION FOR ^{152}Sm AND ^{154}GD AT LOW TEMPERATURES. Vesna, V. A.; Kaminker, D. M.; Levchenko, P. M. (Inst. of Nuclear Physics, Leningrad). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 74-79(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 87-92(1975).

It has been found that the perturbation of angular $\gamma\gamma$-correlation is determined by different mechanisms in the cases of ^{152}Sm and ^{154}Gd. Whereas in the case of ^{154}Gd one may speak of the quadrupole character of the perturbation due to the action of an external electric field gradients amplified in the atomic shell on the nucleus, in the case of ^{152}Sm the perturbation mechanism is more complicated and cannot be interpreted solely on the basis of the effect of the 4f-shell, since the ratio between the quadrupole and magnetic interactions varies as a function of the magnitude of the interaction. At the same time the perturbation is not directly related to the external fields, since there is no dependence of the perturbation of the $\gamma\gamma$-correlation on the viscosity of the solution. (5 figures) (auth)

21682 ENERGIES AND AMPLITUDES OF THE MIXING OF ^{160}Tb, ^{176}Lu, ^{179}Hf, AND ^{182}Ta ROTATIONAL BANDS. Tambert, J. J.; Balodis, M. K.; Milyuna, M. K.; Neiburg, L. A.; Plate, M. N.; Prokof'ev, P. T. (Inst. of Physics, Riga). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 156-162(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 177-183(1975).

The energy values obtained (in keV) and the values of the mixing amplitudes of the rotational bands of ^{160}Tb, ^{176}Lu, ^{179}Hf and ^{182}Ta nuclei are tabulated. In order to estimate the accuracy of the computation method used, the tables display the experimental energy values of the levels. A good agreement is observed between the calculated values of energy and the experimental values; the average deviation $\Delta = E_{theo} - E_{exp}$ in all eight cases of mixed bands is less than 1 keV. In the calculations of the energetics of the bands, the mixing of a large number (up to six) of rotational bands is taken into account. In certain cases (^{160}Tb, ^{176}Lu) the results obtained indicate the necessity of an experimental consideration of bands not yet detected in order to describe the anomalies of the energetics. (16 tables) (auth)

21683 STUDY OF THE SINGLE PARTICLE LEVELS IN DEFORMED NUCLEI EXCITED IN THE (d,p) AND (d,t) REACTIONS. I. Theoretical Consideration; Experimental Procedure and Results. Jaskola, M. (Inst. of Nuclear Research, Warsaw). Nukleonika; 20: No. 9, 823-840(1975).

Formula defining the population of the rotational levels in deformed nuclei excited in a single-neutron transfer reaction are presented. The triton and proton groups from the ^{154}Sm(d,t), ^{156}Gd(d,t), ^{160}Gd(d,t), ^{166}Er(d,t), ^{154}Sm(d,p,) ^{166}Er(d,p), ^{170}Yb(d,p) and ^{176}Yb(d,p) reactions have been measured at deuteron energy 12.1 MeV. The reaction products were observed with a solid state counter and with a magnetic spectrograph. Part II is concerned with analysis of the data and with the configuration mixing. (8 tables, 6 figures) (auth)

21684 K INTERNAL CONVERSION NEAR THRESHOLD AND SOME NUCLEAR STRUCTURE STUDIES IN THE RARE EARTH REGION USING RADIOACTIVE DECAY AND REACTIONS. Visvanathan, A. Notre Dame, IN; Univ. of Notre Dame (1975). 108p. University Microfilms Order No. 75-19,961.

Thesis (Ph. D.).

A study of K internal conversion near threshold is presented. The XPG technique was employed with Si(Li) detectors being used to obtain singles and coincidence spectra. Five transitions were studied, none of which had an energy that exceeded the K binding energy by more than 4 keV. The alpha/sub K/ values obtained are 1,02 +- 0,15 (63,1 keV E1 in ^{169}Tm), 0,75 +- 0,05 (72,0 keV E1 in ^{187}Re), 10,25 +- 0,58 (67,1 keV M1 in ^{174}Lu), 11,4 +- 0,67 (57,8 keV M1 in ^{162}Ho), and 12,04 +- 0,07 (56,6 keV M1 in ^{164}Ho). These results are compared to those of other workers, and to theoretical values. The (alpha, 2n) reaction at 24 MeV was used to populate states in the gamma band of ^{166}Er. Two new members, the 9^+ and 10^+ states of the gamma band are proposed at 1751,0 keV and 1964,3 keV respectively. E2/M1 admixtures in transitions depopulating the gamma band were derived from the gamma angular distributions, and are compared with results obtained from gamma-gamma angular correlations and Coulomb excitation measurements. The (^{7}Li, alpha : 2n) reaction was studied at energies between 24 and 32 MeV with some rare earth targets. Angular distributions of alpha particles and gamma-rays provide evidence for describing the reaction as one of cluster transfer at grazing incidence along a Coulomb trajectory. The deduced interaction radius is R/sub c/ equals 11,2 fm. The degree of alignment and the angular momentum transferred are discussed. A study of the decay of ^{156}Tb, indicated that the 5 hr, and 24 hr, isomers decay independently to the ground state (5 d). The isomeric transition was not observed, but the experiment served to place either an upper limit of 15 keV on its energy or a lower limit of 500 ns on the half-life of the 49 keV state. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 21066, 21067, 21603, 21618, 21630, 21631, 21666, 21675, 21678, 21700, and 21759.

21685 (COO-1779-49, pp 1-11) ELECTRON CAPTURE DECAY OF ^{204}Bi. Cross, J. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

A tentative decay scheme for ^{204}Bi based primarily upon intensity balances and energy sums is proposed. Energies and relative intensities of gamma rays are given. (BJG)

21686 (COO-1779-49, pp 12-22) ELECTRON CAPTURE DECAY OF ^{203}Bi. Cross, J. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The electron capture decay scheme of ^{203}Bi is studied. Energies and relative intensities of gamma rays are given. (BJG)

21687 (COO-1779-49, pp 23-30) ELECTRON CAPTURE DECAY OF ^{205}Bi. Kosanke, K. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

A summary of gamma-gamma coincidence results for ^{205}Bi decay and a first coincidence decay scheme is presented. (auth)

21688 (COO-1779-49, pp 31-34) N AND O CONVERSION LINES FROM THE 2,3-keV TRANSITION IN ^{205}Pb. Johnston, W. C.; Kosanke, K. L. [nd].

In nuclear chemistry at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The low energy electron spectra of ^{205}Bi and ^{206}Bi is studied in order to obtain the energies and intensities of the conversion electrons from the 2,3-keV transition in the ^{205}Pb daughter. (auth)

21689 (COO-1779-49, pp 35-46) DECAY OF ^{201}Pb. Doebler, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Singles experiments with different Ge(Li) detectors, anticoincidence, integral coincidence, and two-dimensional megachannel coincidence experiments are performed to study the ^{201}Pb gamma rays. The 945.96-keV peak is shown to be a doublet, consisting of a moderately strong 945.90-keV component and a very weak 946.78-keV one. (auth)

21690 (COO-1779-49, pp 47-58) DECAY OF ^{199}Pb. Doebler, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Singles, anticoincidence, and gamma-gamma coincidence experiments are used to investigate the decay of 90 minute ^{199}Pb. Some beta$^+$ population of the 1120.9-, 720.3-, and 366.9-keV levels are proposed. (BJG)

21691 (COO-1779-49, pp 59-62) RADIATIONS FROM THE DECAY OF ^{198}Pb. Doebler, R.; McHarris, W. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The electron capture decay of ^{198}Pb is used to study the excited states in ^{198}Tl. (BJG)

21692 (COO-1779-49, pp 63-68) NEW INFORMATION ABOUT THE Pb ISOMERS. Doebler, R.; Guile, J. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Experiments to determine the gamma-ray intensities for /sup 202m/Pb are performed. A decay scheme for /sup 202m/Pb showing new transitions in both ^{202}Pb and ^{202}Tl is presented. (BJG)

21693 (COO-1779-49, pp 209-216) SYSTEMATICS NOW AVAILABLE IN THE Pb-Bi REGION. McHarris, W.; Doebler, R.; Cross, J.; Kosanke, K. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

Transitions and states in the neutron-deficient isotopes /sup 207 m/Pb, /sup 206 m/Pb, /sup 205 m/Pb, /sup 204 m/Pb, /sup 203 m/Pb, /sup 202 m/Pb, /sup 201 m/Pb, and /sup 200 m/Pb are studied. (BJG)

21694 (JINR-P1-9217) ENERGY CHARACTERISTICS OF INTERACTIONS OF π^- MESONS WITH NUCLEI AT 50 GeV/c. Salomov, Dzh.; Tolstov, K. D.; Khoshmukhamedov, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The momentum and angular characteristics of the secondary particles in inelastic interactions of π^--mesons with the nuclei of emulsion irradiated under a strong magnetic field have been studied. The description of experiment carried out with the help of set-up "Mamont" and irradiation conditions in the Serpukhov accelerator has been done. The single-particle distributions have been analysed as functions of the number of heavily ionizing particles. The mean transverse momenta of π^- and π^+-mesons and the energy fractions, carried by these particles, depend weakly on the nucleus-target size. In the pion-nucleus collisions the effect of "leading particle" is maintained however the hypothesis about its full "passivity" contradicts the experimental data. (6 figures, 2 tables) (auth)

21695 EVALUATION OF NEUTRON AND GAMMA-RAY-PRODUCTION CROSS-SECTION DATA FOR LEAD. Fu, C. Y.; Perey, F. G. (Oak Ridge National Lab., TN). At. Data Nucl. Data Tables; 16: No. 5, 409-450(Nov 1975).

A survey was made of the available information on neutron and gamma-ray-production cross-section measurements of lead. From these and from relevant nuclear-structure information on the Pb isotopes, recommended neutron cross-section data sets for lead covering the neutron energy range from 0.00001 eV to 20.0 MeV have been prepared. The cross sections are derived from experimental results available to February 1972 and from calculations based on optical-model, DWBA, and Hauser-Feshbach theories. Comparisons which show good agreement between theoretical and experimental values are displayed in a number of graphs. Also presented graphically are smoothed total cross sections, Legendre coefficients for angular distributions, and a representative energy distribution of gamma rays from resonance capture. 15 tables, 36 figures, 104 references. (auth)

21696 ABSORPTION CROSS-SECTION MEASUREMENTS FOR ^{252}Cf SPONTANEOUS FISSION NEUTRONS. Green, L. (Westinghouse Electric Corp., West Mifflin, PA). Nucl. Sci. Eng.; 58: No. 4, 361-370(Dec 1975).

Absolute absorption cross sections of ^{232}Th and ^{197}Au for ^{252}Cf spontaneous fission neutrons have been measured. Irradiations were performed in an exceptionally low mass source-foil arrangement, providing a "pure" spectrum with few corrections. Calibration of the activation detector was achieved by irradiating identical foils in the Standard Thermal Flux at the National Bureau of Standards. The results obtained were 79.9 +- 2.9 mb for ^{197}Au and 87.8 +- 4.0 mb for ^{232}Th. The corresponding values calculated from ENDF/B-III data are 84.3 and 99.3 mb, respectively. A simple ratio technique was also used to obtain an independent estimate of the relative ^{232}Th to ^{197}Au integral cross sections, yielding a value in good agreement with that above. This technique was extended to ^{181}Ta, ^{98}Mo, and ^{63}Cu. 5 tables, 3 figures. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 21573, 21574, 21603, 21630, 21678, 21696, and 22481.

21697 (ANL-8010, pp 1-18) FISSION PROPERTIES AND CROSS-SECTION DATA. 1972.

In Applied Physics Division annual report, July 1, 1971–June 30, 1972. (Argonne National Lab., Ill. (USA)).

Experimental and theoretical studies of neutron interactions with those nuclei found in the structural and fuel components of reactor systems were carried out. This work was performed principally to provide information necessary for optimal reactor-physics design. The major portion of the effort was devoted to studies of fast-neutron-induced processes, especially those which are important in fast reactors. The studies were directed toward neutron elastic and inelastic scattering, neutron-induced reactions including capture, and the determination of the characteristics of the fission process. (auth)

21698 (ANL/NDM-18) DELAYED NEUTRON YIELD OF ^{238}U AND ^{241}Pu. Meadows, J. W. (Argonne National Lab., Ill. (USA)). Jan 1976. 24p. Dep. NTIS $3.50.

The total delayed neutron yield for ^{238}U and ^{241}Pu were observed as a function of the incident neutron energy. The measurements extend from 2.5 to 5 MeV for ^{238}U and from 0.15 to 5 MeV for ^{241}Pu. The average ratio of the ^{241}Pu delayed neutron yield to that of ^{238}U is 0.292 +- 0.022.

21699 (COO-1779-49, pp 221-223) CLUSTER TRANSFER REACTIONS FOR PRODUCING EXOTIC NUCLEI. McHarris, W. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The (^{16}O,alpha) reaction is examined as a potential tool for producing trans-actinide and possibly even super-heavy elements. (auth)

21700 (NEANDC(E)-162"U"(Vol.4)) NEANDC ACTIVITY REPORT FOR THE YEAR 1974. Schmitt, A. P. (ed.). (Nuclear Energy Agency, 75 - Paris (France). Nuclear Data Committee). 1975. 65p. (In French). Dep. NTIS (US Sales Only) $5.50.

Reports are given of neutron cross section measurements made at Bruyeres-le-Chatel, Cadarache, Fontenay aux Roses, Grenoble, and Saclay. (JSR)

21701 (TID-26950) RECOIL-DISTANCE LIFETIME MEASUREMENTS AND MULTIPLE COULOMB EXCITATION STUDIES OF ^{236}U. Guidry, M. W. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. 100p. Dep. NTIS $5.00.

Thesis submitted to Univ. of Tennessee.

Recoil-distance lifetime measurements and multiple Coulomb excitation studies have been performed for the 4^+, 6^+, 8^+, 10^+, and 12^+ members of the ^{236}U ground-state rotational band. The recoil-distance data were analyzed with a theoretical correction procedure that was developed during the course of this work and implemented in a computer code ORACLE. The half-lives determined by the recoil-distance technique were 124.0 +- 7.3 ps (4^+), 58.2 +- 3.3 ps (6^+), 23.9 +- 1.9 ps (8^+), 11.6 +- 1.1 ps (10^+), and 5.5 +- 2.2 ps (12^+). These correspond to B(E2, I/sub i/ yields I/sub i/ - 2)/e^{2}b^2 values of 3.03 +- 0.20 (4^+), 3.28 +- 0.19 (6^+), 3.42 +- 0.28 (8^+), 3.11 +- 0.30 (10^+), and 3.34 +- $^{0.35}_{0.23}$ (12^+). Transition quadrupole moments Q_{20}(I/sub i/ yields I/sub f/) extracted from the B(E2) values are constant within experimental error and support the interpretation of ^{236}U as a good rotor for I/sup pi/ less than or equal to 12^+. The comparison of multiple Coulomb

excitation probabilities with those predicted by theory has confirmed the sign of the E4 moment in ^{236}U as positive. This is in agreement with theoretical predictions and resolves a previous ambiguity in the sign of the moment as determined by alpha-particle Coulomb excitation. The success of this work has demonstrated that recoil-distance measurements and multiple Coulomb excitation are important complementary techniques in the study of high-spin rotational states. 36 figures, 10 tables, 99 references. (auth)

21702 ABSOLUTE DETERMINATIONS OF THE ^{239}Pu FISSION CROSS SECTION AT 140, 265, AND 964 keV. Davis, M. C.; Robertson, J. C.; Engdahl, J. C.; Knoll, G. F. (Univ. of Michigan, Ann Arbor). Trans. Am. Nucl. Soc.; 22: 663-664(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21703 ABSOLUTE MEASUREMENT OF THE 14.6-MeV NEUTRON FISSION CROSS SECTION OF ^{235}U AND ^{238}U. Cance, M.; Grenier, G. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Trans. Am. Nucl. Soc.; 22: 664-665(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21704 HIGH-RESOLUTION MEASUREMENT OF THE ^{237}Np (n,f) CROSS SECTION FROM 100 keV TO 2 MeV. Plattard, S. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France); Pranal, Y.; Blons, J. Trans. Am. Nucl. Soc.; 22: 665-667(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21705 TIME-OF-FLIGHT MEASUREMENT OF PROMPT-NEUTRON FISSION SPECTRA OF ^{235}U AND ^{238}U. Bertin, A.; Bois, R.; Frehaut, J. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Trans. Am. Nucl. Soc.; 22: 667-668(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21706 NEW DELAYED-NEUTRON SPECTRA AND THEIR IMPORTANCE IN FAST REACTOR DYNAMIC CALCULATIONS. Saphier, D. (Argonne National Lab., IL); Ilberg, D.; Shalev, S.; Yiftah, S.; Daly, T. A. Trans. Am. Nucl. Soc.; 22: 671-672(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21707 PROMPT-NEUTRON EMISSION AND PRIMARY FISSION FRAGMENT YIELDS. Liaw, J. R.; Spinrad, B. I. (Oregon State Univ., Corvallis). Trans. Am. Nucl. Soc.; 22: 672-673 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21708 EVALUATION OF NEUTRON YIELDS FROM SPONTANEOUS FISSION OF TRANSURANIC ISOTOPES. Johnson, D. L. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 673-675(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21709 ^{252}Cf SOURCE ENHANCEMENT MEASUREMENT TO DETERMINE $\overline{\nu\sigma_f}$ OF ^{238}U. Lee, B. W.; Levine, S. H. (Pennsylvania State Univ., University Park). Trans. Am. Nucl. Soc.; 22: 676-677(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21710 MONOENERGETIC NEUTRON FISSION OF ^{238}U. Flynn, K. F.; Nagy, S.; Glendenin, L. E.; Gindler, J. E.; Meadows, J. W. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 677-679(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21711 EVALUATION AND REPRESENTATION OF SECONDARY SPECTRA OF (n,2n) AND (n,3n) IN ^{238}U. Segev, M. (Argonne National Lab., IL); Caner, M.; Yiftah, S. Trans. Am. Nucl. Soc.; 22: 679-680(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21712 STATISTICS OF FISSION WIDTHS FOR PARTLY OPEN FISSION CHANNELS. Cook, J. L.; Rose, E. K. (Australian Atomic Energy Commission Research Establishment, Sutherland). Aust. J. Phys.; 28: No. 5, 489-494(Oct 1975).
The statistical distributions of the fission widths for neutron fission of ^{235}U are examined in the $J^\pi = 3^-$ and 4^- states of the compound nucleus. A χ^2 fit to each set of widths indicates that the $J^\pi = 3^-$ state has two partly open channels. This contention is supported by a further fit to the χ^2 distribution with varying degrees of freedom. Contrary to earlier predictions, it is found that the $J^\pi = 4^-$ state has three partly open channels. (auth)

21713 STABILITY OF SUPER-HEAVY NUCLEI: SOME RECENT RESULTS OF SELF-CONSISTENT CALCULATIONS. Beiner, M. (IPN, Orsay, France); Flocard, H.; Veroni, M.; Quentin, P. Phys. Scr.; 10A: 84-89(1974).
From 20th nobel symposium; Ronneby, Sweden (11 Jun 1974).
Self-consistent calculations of super-heavy elements are presented. The Skyrme effective interaction SIII has been used. This force gives an overall good fit of a wide range of nuclear properties, in particular for closed shell nuclei. The quality of these results puts reasonable limits on the reliability of extrapolation to unknown nuclei. Q_α and Q_β values are calculated and corresponding lifetimes are estimated. For the nucleus $^{298}114$, the fission barrier has been obtained by a constrained self-consistent calculation. (7 tables, 5 figures) (auth)

21714 SUPERFLUID VERSUS VISCOUS DESCENT FROM SADDLE TO SCISSION. Bjornholm, S. (Niels Bohr Inst., Copenhagen). Phys. Scr.; 10A: 110-114(1974).
From 20th nobel symposium; Ronneby, Sweden (11 Jun 1974).
The spectrum of mass yields from spontaneous fission and thermal neutron induced fission of even nuclides sometimes shows a fine structure, indicating a preference for doubly even mass divisions. This occurs only when the fissility parameter is relatively small. For a given nuclide, the fine structure is more pronounced when the total kinetic energy carried away by the fragments is larger than average. The preference for doubly even mass divisions is interpreted as the preservation of superfluidity, i.e., of the paired configuration, during the descent from saddle to scission. Conversely, loss of fine structure means excitation of quasiparticles during the descent. Alternative models for the saddle-to-scission transition are discussed in relation to the observed variance in the number of neutrons evaporated from a single fragment, under the constraint of a fixed total kinetic energy and a fixed mass ratio. It is concluded that fine structure in the mass yields may also occur, when the total kinetic energy is much lower than average. (7 figures) (auth)

21715 EXPERIMENTAL OBSERVABLES AND THE FISSION BARRIER. Specht, H. J. (Univ., Heidelberg). Phys. Scr.; 10A: 21-29(1974).
From 20th nobel symposium; Ronneby, Sweden (11 Jun 1974).
The experimental evidence supporting the double humped character of the fission barrier in actinide nuclei is reviewed and compared with theoretical predictions. The discussion covers the properties of spontaneously fissioning isomers, intermediate structure in fission cross sections, the systematics of fission barrier heights, and the implications of a possible octupole deformation at the second barrier for fragment mass distributions. (11 figures) (auth)

21716 EXPERIMENTS CONCERNING THE SYNTHESIS OF SUPERHEAVY ELEMENTS. Stephan, C. (Institut de Physique Nucleaire, Orsay, France). Phys. Scr.; 10A: 41-46(1974).
From 20th nobel symposium; Ronneby, Sweden (11 Jun 1974).
Experiments made at Orsay to synthesize superheavy elements by heavy ion induced reactions are described, and the results are presented. An attempt to explain the negative results obtained is presented, based on the mechanisms of the reaction involved: interaction barrier, critical distance of approach, deep inelastic transfers. (7 figures) (auth)

21717 REVIEW OF RECENT SHE PREDICTIONS. Sobiczewski, A. (Institute for Nuclear Research, Warsaw). Phys. Scr.; 10A: 47-52(1974).
From 20th nobel symposium; Ronneby, Sweden (11 Jun 1974).
Recent predictions for lifetimes of superheavy ($A \approx 300$) and super-superheavy ($A > 300$) nuclei are reviewed. Various factors affecting the predicted lifetimes and the uncertainties in these predictions are discussed. (8 figures) (auth)

21718 SINGLE-PARTICLE MECHANISM BEHIND THE ASYMMETRIC DISTORTIONS. Larsson, S. E.; Moeller, P.; Nilsson, S. G. (Lund Inst. of Tech., Sweden). Phys. Scr.; 10A: 53-59(1974).
From 20th nobel symposium; Ronneby, Sweden (11 Jun 1974).
The relation between nuclear shell structure and nuclear shapes is brought out in diverse mass regions. Thus certain nuclear orbitals, shown to be responsible for the development of mass-asymmetric distortions, are here followed in more detail for large and realistic shape changes. The same holds for axial asymmetries. The study is applied to actinide and superheavy

nuclei as well as very light ones, among the latter ^{24}Mg, which is shown to exhibit a deep octupole-shape second minimum. (14 figures) (auth)

21719 SEARCH FOR SUPERHEAVY ELEMENTS IN NATURE. Herrmann, G. (Univ., Mainz). Phys. Scr.; 10A: 71-76(1974).

From 20th nobel symposium; Ronneby, Sweden (11 Jun 1974).

A review is given of the methods used in the search for superheavy elements in nature and of the results obtained. It is concluded that there is no convincing evidence for the presence of such elements in nature. (8 figures, 1 table) (auth)

21720 FISSION CROSS SECTION OF ^{235}U FROM 0.8 TO 4 MeV. Czirr, J. B.; Sidhu, G. S. (Univ. of California, Livermore). Nucl. Sci. Eng.; 58: No. 4, 371-376(Dec 1975).

The relative energy dependence of the ^{235}U fission cross section has been measured with respect to the (n, p) scattering reaction for neutron energies from 0.8 to 4 MeV. The Lawrence Livermore Laboratory Linac provided a pulsed source of neutrons, and energies were measured by neutron time of flight. The flux monitor consisted of a thin annular polyethylene proton radiator with a shielded recoil detector. The total error in the relative ^{235}U(n, f) cross section is less than 1.5 percent from 0.8 to 4 MeV. (5 figures, 1 table) (auth)

21721 ANALYTICAL REPRESENTATION OF SOME FAST-NEUTRON CROSS SECTIONS USEFUL IN DOSIMETRY. Cross, W. G.; Ing, H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Sci. Eng.; 58: No. 4, 377-386(Dec 1975).

Empirical expressions are given for the excitation functions of a number of (n, n'), (n, p), and (n, f) reactions useful in the dosimetry of fast neutrons. For fission cross sections, the expressions are fitted to existing evaluations while for activation cross sections, they are fitted to recent experimental data. Average cross sections, derived from these expressions, for various fission neutron spectra are compared with measured values. 1 table, 6 figures. (auth)

21722 RESONANCE REGION ANALYSIS WITHOUT RESONANCE PARAMETERS. Pearlstein, S. (Brookhaven National Lab., Upton, NY). Nucl. Sci. Eng.; 58: No. 4, 354-360(Dec 1975).

A representation for structured data is described that does not make use of a resonance parameter formalism and is applicable in a region where resonance parameters cannot be resolved or in a resolved resonance region where the precise location of a resonance is unimportant. Following the Probability Table Method, a representation statistically equivalent to a pointwise description of data is given but extended to characterize energy correlations. In the case of data from which higher order derivatives can be taken, a method for temperature broadening and unbroadening data is presented. 7 figures. (auth)

21723 DISTRIBUTION OF FISSION YIELDS IN THE 2.95 MeV AND 14.8 MeV NEUTRON-INDUCED FISSION OF ^{238}U. Adams, D. E. II. Fayetteville, AR; Univ. of Arkansas (1975). 128p. University Microfilms Order No. 75-27,644.

Thesis (Ph. D.).

The mass yield distribution of 46 and 18 mass chains in the region A equals 83-157 have been measured radiochemically for the 14.8 MeV and 2.95 MeV neutron-induced fission of ^{238}U, respectively. The absolute activities of each nuclide measured in this mass region were determined by gross beta counting and the cumulative fission yields were measured relative to ^{99}Mo in the fission of ^{238}U with 14.8 MeV neutrons and ^{140}Ba in the fission of ^{238}U with 2.95 MeV neutrons. The yields determined in this investigation are compared to all known literature values. Six fission yields are presented that have been experimentally measured for the first time for the 14.8 MeV neutron-induced fission of ^{238}U and twelve fission yields are presented for the first time for the 2.95 MeV neutron-induced fission of ^{238}U. The 14.8 MeV fission yields measured make up about 115 percent of the total 200 percent expected from fission. As reported previously in the literature, fine structure in the fission of ^{238}U with 14.8 and 2.95 MeV neutrons was observed to exist at mass number 134 and no clear evidence could be found for fine structure at other mass numbers. (Diss. Abstr. Int., B)

21724 VIRTUAL EXCITATIONS OF THE NUCLEUS IN BOUND STATE AND SCATTERING PROBLEM. Ara, G. New York; Columbia Univ. (1975). 77p. University Microfilms Order No. 75-27,377.

Thesis (Ph. D.).

The effects of virtual excitations of the nucleus are studied both for the bound state and for the scattering problem. For the bound state problem, the discrepancies between the measured and the calculated energies of the SIGMA$^-$, anti p and K^- atoms of the ^{238}U have been resolved by the proper inclusions of the effects of virtual excitations of the lowest rotational state 2^+. For the scattering problem, a framework of numerical computation with second order distorted wave Born approximation has been established. Sample calculations which illustrate the importance of the two body correlations in the nuclear ground state and the possible effects of the dispersive corrections on the skin-thickness of the nuclear charge distribution have been carried out. (Diss. Abstr. Int., B)

21725 THEORETICAL ESTIMATES OF SPONTANEOUS-FISSION HALF-LIVES FOR SUPERHEAVY ELEMENTS BASED ON THE MODIFIED-OSCILLATOR MODEL. Randrup, J. (Univ. of California, Berkeley); Larsson, S. E.; Moeller, P.; Sobiczewski, A.; Lukasiak, A. Phys. Scr.; 10A: 60-64(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The stability problem for the superheavy elements has been reconsidered based on the use of the shape-dependent droplet model and the modified-oscillator potential. The effect of axial asymmetry on the barrier heights is included. A semi-empirical inertial-mass function is employed. Alternatively the inertial-mass parameters are calculated microscopically. The spontaneous-fission half-lives are calculated with these inertias. Both of the latter were renormalized to give optimal agreement with experimental half-lives in the actinide region. The resulting spontaneous-fission half-lives in the SHE region are somewhat shorter than those of most previous estimates, predicting, for example, around 10^5 years as the total half-life for the most stable nucleus $^{294}110$. 8 figures, 1 table. (auth)

21726 PRELIMINARY STUDY OF ADDITIONAL EFFECTS WITH BEARING ON THE BARRIER HEIGHTS FOR SUPERHEAVY ELEMENTS. Larsson, S. E. (Lund Inst. of Tech., Sweden); Leander, G.; Ragnarsson, I.; Randrup, J. Phys. Scr.; 10A: 65-70 (1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The effects of the simultaneous presence of monopole and quadrupole pairing interactions on the fission barriers for heavy and superheavy elements are considered. The first barrier for light Th isotopes is found to be raised by 1 MeV, while heavier actinide nuclei seem to be less affected by the inclusion of quadrupole pairing. For the superheavy elements, the inclusion of quadrupole pairing tends to increase the barriers considerably. Moreover, the Coulomb energy, associated with the non-homogeneous charge distribution of the modified oscillator model, is compared with the liquid-drop value and with the value emerging from a self-consistent calculation based on the Skyrme interaction. The shell effect, which may be several MeV in magnitude, appears to be highly sensitive to model assumptions concerning the forces between neutrons and protons. 7 figures. (auth)

21727 SUPERHEAVIES IN NATURE: WHERE AND HOW TO LOOK. Nurmia, M. (Univ. of California, Berkeley). Phys. Scr.; 10A: 77-80(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

In searching for superheavy elements in nature it is usually assumed that the SHE (1) follows the chemistry of its lighter homolog and (2) decays by spontaneous fission. The sensitivity of SHE detection can be substantially improved by replacing these assumptions by a consideration of the geochemical fractionation processes, and by using a mass spectrometer. A good candidate for a search would be element 112, eka-mercury. It is expected to be more volatile and more noble than Hg so that it may behave like a heavy rare gas and be concentrated in the earth's atmosphere. 5 tables, 2 figures. (auth)

21728 SEARCH FOR NEW ELEMENTS: THE PROJECTS OF TODAY IN A LARGER PERSPECTIVE. Seaborg, G. T. (Univ. of California, Berkeley). Phys. Scr.; 10A: 5-12(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The search for new elements is based on the irradiation of heavy element targets with heavy ions followed by identification through physical or chemical methods. Success seems assured for the production and identification of short-lived elements immediately beyond the heaviest presently known. Predictions indicate that still heavier elements, the superheavy elements as part of an "island of stability," would have sufficient stability to allow their identification; however, there is no equal assurance that nuclear reactions suitable for their synthesis can be found. The chemical properties of a wide range of such prospective new elements have been predicted, in many cases in rather extensive detail. Special considerations related to their high atomic numbers suggest interesting differences between the chemical properties of these heavy elements and their lighter homologs. Chemical separation schemes for the identification of superheavy elements have been devised and applied to heavy targets irradiated with heavy ions. While there may be some positive indications of such identification in experiments performed at Dubna, experiments at Berkeley have given negative results. In the Berkeley experiments the yields of a broad range of isotopes of the known ele-

ments in the separated chemical fractions have been determined. The resulting distribution of products formed in the irradiation of uranium with krypton ions suggest some interesting new reaction mechanisms. 8 figures, 2 tables. (auth)

Nuclear Theory

Refer also to abstracts 21419, 21528, 21616, 21762, 21770, 21853, and 21890.

21729 (CONF-7309135-) FRONTIER PROBLEMS ON NUCLEAR AND SOLID STATE PHYSICS. International Summer School Held at Predeal, Romania, September 6–15, 1973. Corciovei, A.; Dorobantu, I. A. (eds.). (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 464p.

The conference included 12 papers. Separate abstracts were prepared for seven abstracts. Other papers were outside the scope of NSA.

For abstracts of individual papers see: 21633, 21730–21733, 21852, and 21853.

21730 (CONF-7309135-, pp 104-154) BOSON EXPANSION TECHNIQUES. Dreizler, R. M. (Univ., Frankfurt am Main). 1973.

From international summer school on boundary problems between nuclear and solid state physics; Predeal, Romania (6 Sep 1973).

In frontier problems on nuclear and solid state physics.

Lectures are given on an application of boson expansions for a many-body system, the atomic nucleus. (JFP)

21731 (CONF-7309135-, pp 155-191) NUCLEAR JOSEPHSON EFFECT. Hara, K. (Technische Univ., Munich). 1973.

From international summer school on boundary problems between nuclear and solid state physics; Predeal, Romania (6 Sep 1973).

In frontier problems on nuclear and solid state physics.

Lectures are presented giving a qualitative discussion of the nuclear Josephson effect within the framework of the semi-classical theory of nuclear reactions. (JFP)

21732 (CONF-7309135-, pp 192-208) PARITY NONCONSERVATION IN HEAVY NUCLEI. Dumitrescu, O. (Inst. of Atomic Physics, Bucharest). 1973.

From international summer school on boundary problems between nuclear and solid state physics; Predeal, Romania (6 Sep 1973).

In frontier problems on nuclear and solid state physics.

Some important theoretical efforts made in the recent numerical calculations concerning the parity violation in the atomic nuclei are discussed, and an attempt is made to improve some methods aiming at the many-body nuclear wave functions. The particular cases of lutetium-175 and tantalum-181 are considered. (JFP)

21733 (CONF-7309135-, pp 252-315) CHANNELING: SOME EXPERIMENTAL ASPECTS AND THE TRANSFER MATRIX TECHNIQUE APPROACH. Corciovei, A. (Inst. of Atomic Physics, Bucharest). 1973.

From international summer school on boundary problems between nuclear and solid state physics; Predeal, Romania (6 Sep 1973).

In frontier problems on nuclear and solid state physics.

A review is given of experimental work demonstrating the existence of directional effects and how certain physical processes can be studied by means of channeling. Also the recently developed transfer matrix technique for hyperchanneled particles is sketched by using a binary collision model. (JFP)

21734 (LYCEN-7502) THIRD BIENNIAL SESSION OF NUCLEAR PHYSICS STUDIES HELD AT LA TOUSSUIRE, FRANCE, FEBRUARY 10–15, 1975. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire). 1975. vp. (In French and English). CONF-750241–).

Individual abstracts are prepared for each of the 25 presented papers. (BJG)

For abstracts of individual papers see: 21587, 21588, 21609, 21637, 21675, 21735–21752, 21855, and 21856.

21735 (LYCEN-7502, pp C.1.1-C.1.11) UNIFIED THEORY OF NUCLEAR REACTIONS. Tobocman, W. (Case Western Reserve Univ., Cleveland). 1975.

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

A unified nuclear reaction theory is a formalism for the scattering reactions of manybody nuclear systems which is capable of describing both direct interaction and compound nucleus formation processes. The Feshbach projection operator formalism is the original unified nuclear reaction theory. An alternative unified nuclear reaction theory called the X-matrix formalism is described. The X-matrix formalism is a generalization of the Brown-de Dominicis formalism. It does not require projection operators and is readily applied to rearrangement collisions. (auth)

21736 (LYCEN-7502, pp C.2.1-C.2.11) VARIATIONAL PRINCIPLES FOR NUCLEAR REACTIONS. Tobocman, W. (Case Western Reserve Univ., Cleveland). 1975.

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

In the quantum mechanical m-level approximation the problem is solved exactly in a restricted basis of m states. For the bound state problem this reduces to the determination of the eigenvalues and eigenvectors of a Hermitian $m \times m$ matrix. For the scattering problem the method requires the approximate inversion of an operator using an m state basis. This approach may be used in conjunction with variational principles for scattering. Particular attention is paid to the complications connected with multipartition or rearrangement scattering. (auth)

21737 (LYCEN-7502, pp C.5.1-C.5.13) MASS PARAMETERS IN THE ADIABATIC APPROXIMATION. Vautherin, D. (Institut de Physique Nucleaire, Orsay, France). 1975. (In French)

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

Heavy ion reactions and the vibrations of soft nuclei are studied in the framework of the time-dependent Hartree-Fock method and the limitations of the method in the adiabatic case are defined. This method is studied in the case where the effective interaction acting between two nucleons is the Skyrme interaction. (23 references). (JSR)

21738 (LYCEN-7502, pp C.6.1-C.6.30) HYPERSPHERICS AND THE SHELL MODEL. Fabre de la Ripelle, M. (Institut de Physique Nucleaire, Orsay, France). 1975. (In French)

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

In the development of the hyperspheric formalism for a description of the nucleus, it is necessary to take into consideration the oscillator interaction. Some properties of the oscillator and of the Slater determinants which play a large role in the development of this formalism are studied. As an example the ground states of the light nuclei $4 < A \leq 16$, whose external nucleons are placed in the p shell, are considered. (JSR)

21739 (LYCEN-7502, pp C.7.1-C.7.8) APPLICATIONS OF COUPLED EQUATIONS. Raynal, J. (CEN, Saclay, France). 1975. (In French)

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

The application of the coupled equations in sequential iteration method, a computer program ECIS, to the study of nuclear reactions is illustrated on three examples. These are the effect of the quadrupole moment of the excited state (particularly the analyzing capacity in the inelastic scattering of polarized protons), inelastic scattering of α particles at 104 MeV with the anharmonic vibrational model and the folding model and the generalization of the program in these two regions, and the application to the inelastic scattering of heavy ions. (JSR)

21740 (LYCEN-7502, pp C.8.1-C.8.37) RECOIL AND FINITE RANGE EFFECTS IN HEAVY-ION TRANSFER REACTIONS. Elbaz, E. (Univ., Lyon). 1975.

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire).

Different possible expansions of a function of a sum of two vectors are reviewed. The general formalism of the heavy-ion transfer reaction is given. The no-recoil approximation and different possible simplifications are discussed along with the different approximate and exact treatments of the recoil and finite range effects. The graphical treatment of angular momentum algebra is extensively used. (25 references) (auth)

21741 (LYCEN-7502, pp C.9.1-C.9.7) PION FIELD IN THE NUCLEUS. Ericson, M. (Univ., Lyon). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
The conditions under which the pion field of the nucleus affect the processes of β decay are summarized and the equations describing the pion field are derived. The experimental consequences are discussed and the theoretical results are compared with available experimental results. (JSR)

21742 (LYCEN-7502, pp C.10.1-C.10.10) THEORY OF COLLECTIVE MOTION. Giraud, B. (CEN, Saclay, France). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
An almost linguistic analysis of the vocabulary used in the theory of collective motion is presented. The essential points stressed are the following. The favored collective transitions appear bound to a certain factorization of the wave functions. It is important to think of collective subspace rather than collective states. The collective Hamiltonian is only the projection of the nuclear Hamiltonian in such a subspace that requantification problems are avoided. Some hypotheses of adiabaticity and weak coupling are necessary. It is illusory to search for collective parameters without a detailed comprehension of the nature, classical or unclassical, of the collective motion in question. (JSR)

21743 (LYCEN-7502, pp C.11.1-C.11.33) SEMICLASSICAL APPROXIMATION AND COMPLEX TRAJECTORIES. Knoll, J.; Schaeffer, R. (CEN, Saclay, France). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
The complex trajectory method was applied to the calculation of the elastic and inelastic scattering in order to obtain a semiclassical approximation valid at all energies. The analysis of the equations derived show that this method makes the semiclassical approximation more precise than quantum calculations. With it strong absorption of the diffraction can be considered correctly. (JSR)

21744 (LYCEN-7502, pp C.12.1.-C.12.11) DERIVATION OF THE CRANKING HAMILTONIAN BEGINNING WITH THE VARIATIONAL PRINCIPLE. Ripka, G. (CEN, Saclay, France). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
It is shown by means of certain hypotheses, still poorly verified, that is the projected energy is varied by imposing certain symmetries on the mean field, a field is obtained which is equal to the Hartree-Fock field calculated with the cranking Hamiltonian. The formalism is applied to the three regimes of low kinetic momentum, intermediate kinetic momentum, and high kinetic momentum. (JSR)

21745 (LYCEN-7502, pp C.13.1-C.13.24) HEAVY ION PHYSICS. Harar, S. (CEN, Saclay, France). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
The reactions of heavy ions are analyzed to show that analysis by the Hauser-Feshbach statistical model yields information on nuclear structure and on the interactions between ions. These include selectivity, effective cross sections, critical angular momentum in the formation of the compound nucleus, and the spins of states of residual nuclei. Several examples of nucleon transfer in heavy ion reactions are examined in detail. (JSR)

21746 (LYCEN-7502, pp C.14.1-C.14.22) NUCLEON-NUCLEON INTERACTION AT LOW AND MEDIUM ENERGIES. Vinh Mau, R. (Univ. Pierre et Marie Curie, Paris). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
The current theoretical and experimental status of studies on nucleon-nucleon reactions is reviewed with a discussion of experimental studies, phenomenological analyses, semi-phenomenological analyses, and determination of the long-range and medium-range nucleon-nucleon interaction beginning with pion-nucleon and pion-pion interactions. (JSR)

21747 (LYCEN-7502, pp C.15.1-C.15.26) SCATTERING OF HEAVY IONS AND THE MOLECULAR MODEL. Becker, F. (CRN, Strasbourg). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
A model of heavy ion scattering is presented for the case when the relative energy of the two nuclei is slightly larger than the Coulomb barrier and when it is in the vicinity of a virtual quasi-molecular state. The experimental results on which the model is based are reviewed. The essential concepts of the molecular model and the derivation of the equations describing it are discussed. The model is compared with experimental results in simple elastic scattering and the molecular potential obtained in a particular case of a strong coupling with the first excited state is analyzed. These theoretical results are compared with analyses made with DWBA and in the resonant group model. (JSR)

21748 (LYCEN-7502, pp C.16.1-C.16.10) NATURE AND IMPLICATIONS OF CORE POLARIZATION PHENOMENA IN NUCLEAR PHYSICS. Zuker, A. P. (CRN, Strasbourg); Cortes, A.; Pasquini, E. 1975.
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
An approach to the problem of effective interactions based on assumptions different from those in the Bloch-Horowitz theory is proposed. The procedure involves producing a complicated set of "dressed" model states in the presence of coupling Hamiltonians. (BJG)

21749 (LYCEN-7502, pp C.17.1-C.17.35) OBSERVABLES OF NUCLEON-DEUTERON ELASTIC SCATTERING. Fayard, C.; Lamot, G. H.; Elbaz, E. (Univ., Lyon). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
The n-d elastic scattering calculations are improved with a consideration of non-local separable interactions. The Lovelace equations and the different approximation methods of resolving them are first reviewed. The two-body problem is considered and the separable interactions used in the various calculations are described. The results obtained for the observables of n-d scattering are indicated. Some results on the spin correlation coefficients and the dephasing analysis of n-d scattering are given. (JSR)

21750 (LYCEN-7502, pp S.2.1-S.2.2) DENSITY DEPENDENCE OF THE 3-BODY CORRELATION ENERGY IN NUCLEAR MATTER. Grange, P. (CRN, Strasbourg). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
The three-body correlation energy was calculated for seven values of the Fermi moment and compared with the results obtained by Dahlblom. The data are tabulated. (JSR)

21751 (LYCEN-7502, pp S.4.1-S.4.3) SELF-CONSISTENT CALCULATIONS OF THE DEFORMATION PROPERTIES OF SAMARIUM ISOTOPE PAIRS. Decharge, J.; Girod, M.; Gogny, D. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
The results of complete Hartree-Fock calculations made on ^{148}Sm, ^{150}Sm, ^{152}Sm, and ^{154}Sm with use of the D1 interaction are presented. It is shown that interactions of non-zero range can be used for heavy deformed nuclei and that the D1 interaction used in the Hartree-Fock calculations reproduce quite satisfactorily the nuclear deformation properties. (JSR)

21752 (LYCEN-7502, pp S.5.1-S.5.10) ATTEMPT AT THE DIRECT RECONSTRUCTION OF THE pp SCATTERING MATRIX BELOW 500 MeV. Giffon, M. (Univ., Lyon) 1975. (In French)
From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).
In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).
An attempt was made to determine the amplitudes intervening

in pp scattering directly from experimental results. In spite of the lack of much experimental data and the mathematical complexity of the problem, numerical solutions were obtained from a dephasing analysis. (JSR)

21753 (COO-1779-49, pp 204-208) PREDICTIONS OF SPLITTINGS BETWEEN TRIPLET AND SINGLET STATES IN DEFORMED ODD-ODD NUCLEI. Firestone, R. [nd].

In nuclear chemistry research at Michigan State University. Annual report for calendar year 1970. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.).

The development of rules for predicting ground state spins in deformed odd-odd nuclei is discussed. (BJG)

21754 (IPNO-TH-75-09) NEW SEMIPHENOMENOLOGICAL SOFT CORE AND VELOCITY DEPENDENT NUCLEON-NUCLEON POTENTIAL. Lacombe, M.; Loiseau, B.; Richard, J. M.; Vinh Mau, R. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). 1975. 12p. Dep. NTIS (US Sales Only) $3.50.

A nucleon-nucleon potential is constructed which possesses a fundamental theoretical long and medium range part. The short range part is determined phenomenologically by fitting the phase parameters as well as the deuteron properties. Although the number of free parameters is small (six in each isospin state) the quality of the fit is very good. (auth)

21755 (ITP-75-22E) INTEGRAL EQUATIONS FOR FOUR NUCLEONS. II. Angular Momentum Reduction. Levashev, V. P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 32p. Dep. NTIS (US Sales Only) $4.00.

An angular momentum reduction of the integral equations of motion for the four-nucleon system with pair interaction, formulated on the basis of the Faddeev-Yacubovsky approach, is performed. The nucleon-nucleon interaction is assumed to be described by a central potential taking into account the spin and isospin dependences of nuclear forces and acting in all partial states. By going over from Jacobi momentum representation to their moduli and relative angular momentum representation, the variables connected with rotation of the system as a whole are separated out. The integral equations for four nucleons are reduced to an infinite set of three-dimensional equations. (auth)

21756 (ORNL-TM-5000) SELECTED TOPICS IN HEAVY-ION REACTIONS. Wong, C. Y. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 101p. Dep. NTIS $5.45.

A few selected topics in heavy ion reactions are examined. Three aspects specifically addressed are (1) phase transitions of the nuclear fluid, (2) speculations concerning abnormal matter, and (3) nuclei with exotic shapes. The discussion bases on a fluid dynamical description of the reaction process. 42 figures, 1 table, 68 ref. (SDF)

21757 EMISSION AND ABSORPTION OF ELECTROMAGNETIC RADIATION. Alder, K. (Univ. of Basel); Steffen, R. M. pp 1-38 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

The theory of emission and absorption of electromagnetic radiation is presented. The first part is devoted to a general discussion of the electromagnetic field and its properties, and the various multipole moments of the radiation system are introduced. In the second part, the specific nuclear aspects of the emission process of electromagnetic radiation are presented. (auth)

21758 EMISSION OF γ RADIATION AND NUCLEAR STRUCTURE. Alder, K. (Univ. of Basel); Steffen, R. M. pp 39-54 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

Calculations are presented of reduced matrix elements and reduced transition probabilities for emission and absorption of γ radiation by nuclei, based on some simple nuclear models. Specifically, the single particle model and the spherical surface vibration model are considered. (auth)

21759 COLLECTIVE AND MICROSCOPIC MODEL PREDICTIONS OF ELECTROMAGNETIC MOMENTS. Kumar, K. (Vanderbilt Univ., Nashville). pp 55-118 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

A picture of the current understanding of deviations from the selection and intensity rules of the rotational and vibrational models is given. Starting from the general treatment of the collective quadrupole motion of even-even nuclei, the derivation of expressions for the static and transition moments of type E2, M1, E0, and the E2/M1, E0/E2 mixing ratios is discussed. As special cases of these expressions, the rotational model selection rules and the first order band-mixing relations are given. It is emphasized that although the first order perturbation theory provides a useful method of analyzing the experimental data, further extensions of this approach have only limited value. The Pairing-Plus-Quadrupole interaction method for the low-lying states of even-even nuclei is detailed. Comparison with some other approaches is also given. (auth)

21760 NUCLEAR SHAPES AND PHASE TRANSITIONS. Kumar, K. (Vanderbilt Univ., Nashville). pp 119-139 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

A method is discussed which does not require the assumption of a specific nuclear model for determining some quantities which measure the intrinsic nuclear quadrupole moments. For relating these intrinsic moments to nuclear deformations, we do invoke the concept of an equivalent ellipsoid whose charge, volume (or $\langle r^2 \rangle$), and quadrupole moments equal those of the nucleus. But the assumptions of axial symmetry and smallness of deformation are dropped, and this concept is exploited in its full generality. A discussion is also given of the concept of nuclear phase transitions or transitions from spherical to deformed, prolate to oblate and superfluid to normal phases. The last section suggests a connection between the concepts of nuclear shapes and phase transitions along with a method putting them to use. (auth)

21761 GAMMA-RAY TRANSITION PROBABILITIES IN DEFORMED NUCLEI. Loebner, K. E. G. (Technische Univ., Munich). pp 141-171 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

Several general aspects of γ-ray transition probabilities are discussed; these include effective charges, the overlap integral, the enhancement of collective transitions and the influence of the pairing interaction. The evaluation of the reduced transition probability from experimental data and its comparison with theoretical values, including the use of hindrance factors, is discussed. (auth)

21762 COULOMB EXCITATION. Newton, J. O. (Australian National Univ., Canberra). pp 237-282 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

The theory of Coulomb excitation is discussed in a qualitative way in order to illustrate the physical principles and to indicate the type of nuclear structure information which may be obtained. Experimental methods are described with the aim of emphasizing those features which are special to Coulomb excitation. (auth)

21763 NUCLEAR RESONANCE FLUORESCENCE. Skorka, S. J. (Univ., Munich). pp 283-310 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

Since the cross section for nuclear resonance fluorescence (NRF) depends on both the ground state and total widths, NRF experiments may be used to measure lifetimes of excited states. After a brief introduction to NRF, the basic NRF experiments are outlined and a discussion is presented of suitable γ sources, both line and continuous. Emphasis is on measurement of γ transition probabilities. (SDF)

21764 THEORY OF INTERNAL CONVERSION. Pauli, H. C. (Max-Planck-Institut fuer Kernphysik, Heidelburg); Alder, K.; Steffen, R. M. pp 341-440 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

The theory of internal conversion is presented. After a short qualitative discussion of the internal conversion process, the description of the relevant interaction is formulated, and the general techniques for the computation of internal conversion parameters are presented. Internal conversion coefficients and particle parameters are discussed. Various approximation methods (finite nuclear size, screening, higher order corrections, etc.), and their numerical significance are reviewed. The influence of screening and the finite nuclear size, as well as the influence of the chemical environment of an atom on the internal conversion process and, hence, on the nuclear transition probability is discussed. The significance of some internal conversion data on nuclear structure theory is examined. The final section contains several appendices with technical details concerning the Dirac equation and angular momentum algebra. (auth)

21765 ANGULAR DISTRIBUTION AND CORRELATION OF γ RAYS. I. Theoretical Basis. Steffen, R. M. (Purdue Univ., Lafayette, IN); Alder, K. pp 505-582 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

Using a density matrix and statistical tensor formalism, a description is given of the radiation emission process with a view toward understanding angular distributions and correlations of γ radiations. General angular distribution theory is detailed and discussions are given of applications to nuclear resonance fluorescence and the Moessbauer effect. Parity and time reversal symmetries are also considered. (SDF)

21766 EXTRANUCLEAR PERTURBATIONS OF ANGULAR DISTRIBUTIONS AND CORRELATIONS. Steffen, R. M. (Purdue Univ., Lafayette, IN); Alder, K. pp 583-643 of Electromagnetic Interaction in Nuclear Spectroscopy. Hamilton, W. D. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

The time-evolution of density matrices and of statistical tensors that describe oriented ensembles of nuclei that interact with external fields is discussed and the general theory of the influence of such interactions on angular distributions and angular correlations of nuclear radiations is presented. (auth)

21767 SECOND GENERATION ANALYTICAL PHOTO-COMPTON CURRENT METHODS. Dellin, T. A.; Huddleston, R. E. (Sandia Labs., Livermore, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2549-2555(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Analytical transport methods have been developed to predict photo-Compton currents (PCC) in many geometries. This paper presents the "second generation" status of these methods including: (1) a method of determining the azimuthal in addition to the polar angular dependence; (2) an extension to higher order expansions which more accurately predict anguiar distributions; (3) more accurate back yields of low atomic number materials at high photon energies; and (4) more accurate electron scattering cross sections. The analytical methods have now evolved to the point that almost any quantity associated with vacuum photoemission can generally be calculated to within 20 percent agreement with Monte Carlo predictions and experimental data. 5 tables, 6 figures. (auth)

21768 HIGH-ENERGY PROTON-NUCLEUS SCATTERING AND CORRELATIONS. Viollier, R.D. (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). Ann. Phys. (N.Y.) 93: No. 1, 335-368 (5 Sept 1975).

Effects of long-range correlations on high-energy elastic and inelastic proton–nucleus scattering are investigated using the eikonal approximation. We treat multiple scattering of the proton in a coupled channel formalism where virtual excitations and de-excitations of the nucleus are allowed during the scattering process. This is completely equivalent to considering many-body correlations to any order. We also study effects of spin and isospin dependence of the nucleon-nucleon interaction in elastic and inelastic $p+$ nucleus scattering. We propose to use inelastic scattering to known nuclear states as an analyzer of the different components of the nucleon-nucleon interaction. The strong $p+$ nucleus interaction is treated in close analogy to electromagnetic and weak interactions where similar nuclear matrix elements occur. We calculate cross sections and polarizations using all information available from nucleon-nucleon and electron-nucleus scattering. Numerical results are compared with experimental data for elastic scattering of 1 GeV protons on ^{12}C and electric excitations of the $I^{\pi}T$ (E/MeV) = 2^+ 0(4.43), 0^+ 0′ (7.66) and 3^-0(9.64) states in ^{12}C. We predict the differential cross section and polarization for a magnetic transition to the 1^+1(15.11) state in ^{12}C. (auth)

21769 ANTISYMMETRIZATION AND CORE EXCITATION IN DEUTERON-NUCLEUS SCATTERING. Pong, W.S.; Austern, N. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Ann. Phys. (N.Y.) 93: No. 1, 369-401 (5 Sept 1975).

The effects of antisymmetrization in deuteron-nucleus scattering are studied under the assumption that the target is unexcited during scattering. The effective Hamiltonian that governs the motion of the nucleons in the deuteron replaces the free n–p interaction in the deuteron by one that does not scatter the nucleons into occupied states of the target. This modified n–p interaction is constructed by explicit projection of the free n–p interaction onto unoccupied states of the target, and the projection operators used are expressed in terms of single-particle density matrices of the target. The antisymmetrization correction to the deuteron-nucleus optical potential is calculated in configuration space. Applying the local density approximation to the density matrices, and using the short-range character of the free n–p interaction, this correction is expressed as a product of a local factor proportional to the nuclear density, and a short-range nonlocal factor with a range of nonlocality of about 0.5 fm in the nuclear interior. An energy dependent, local potential equivalent to the nonlocal correction is obtained using the local W.K.B. approximation. The real part of the local equivalent potential has a shape similar to that of the nuclear density and gives a 10% reduction to the real part of the deuteron optical potential at energies below about 20 MeV. The imaginary part of the local equivalent potential is negative and peaked at the nuclear surface. It also gives appreciable correction to the optical potential. The effective interaction caused by virtual target excitations is studied. The deuteron excites the target via two different processes: one nucleon in the deuteron excites and de-excites the target, or one nucleon excites the target while the other nucleon de-excites it. The latter process gives rise to a genuine three-body interaction, and its effects are studied in comparison with the effects from the former process. Under the assumption that deuteron internal motion is much slower than deuteron center of mass motion, the effective interactions from both processes are calculated for virtual excitation of the target to one collective vibrational state of definite angular momentum. The effective interactions obtained are very different and the difference originates from the large size of the deuteron. The three-body process seems to have less effect on deuteron elastic scattering than the corresponding process for a single external nucleon. (auth)

21770 SOME ASPECTS OF REDUNDANT STATES IN NUCLEON-NUCLEUS SCATTERING SOLUTIONS WITH ANTISYMMETRIZATION. Krause, T.O.; Mulligan, B. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Ann. Phys. (N.Y.) 94: No. 1, 31-46 (19 Sept 1975).

Redundant states are known to appear as solutions to the scattering equation when an incident particle is antisymmetrized with respect to a target nucleus represented by a Slater determinant. Using criteria which have been found to characterize a potential which produces a continuum bound state (CBS), we demonstrate that a redundant solution can be identified as a CBS which appears at every positive energy. This identification provides a procedure for isolating and removing that portion of the potential responsible for redundant states. The remaining portion of the potential generates solutions to the original scattering equation which we demonstrate to be orthogonal to the redundant states which have been eliminated. (auth)

21771 RENORMALIZATION FOR COLLECTIVE MOTION WITHIN A TRUNCATED SPACE OF THE SPHERICAL SHELL MODEL. I. INTRINSIC FRAME IN A SCHEMATIC MODEL. Harvey, M. (Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada KOJ 1J0). Ann. Phys. (N.Y.) 94: No. 1, 47-82 (19 Sept 1975).

Using schematic Hamiltonians in the ^{20}Ne example, the series of perturbation terms for effective interactions and operators in a truncated space of a spherical shell model is found that, when summed, yields the results for intrinsic moments and energy of the unrestricted deformed Hartree-Fock state. Black-box and random phase approximation diagrams are shown to be important as is another (little used and to be called IBG) diagram and the ladder diagrams. A black-dot vertex renormalization is introduced corresponding to consistent renormalization of every transformation within the model space. The black-dot corresponds exactly to the self-consistency of deformed Hartree-Fock. (auth)

21772 INELASTIC SHADOWING EFFECTS IN MULTIPLE SCATTERING. Londergan, J.T. (Department of Physics, Indiana University, Bloomington, Indiana 47401); Moniz, E.J. Ann. Phys. (N.Y.) 94: No. 1, 83-127 (19 Sept 1975).

The projectile-nucleon scattering amplitudes used as input into multiple scattering theories of projectile-nucleus scattering naturally include the effects of coupling to inelastic (i.e., production) channels. We employ a multichannel separable potential to describe the projectile-nucleon interaction and show that within the fixed nucleon framework we can obtain the nuclear elastic scattering amplitude. This includes terms outside the conventional formalisms, corresponding to intermediate propagation in the inelastic channels both above and below inelastic threshold. We refer to this as inelastic shadowing. In a two-channel approximation, we show that knowledge of the projectile-nucleon elastic scattering phase shifts plus specification of the inelastic threshold energy are sufficient to determine the off-shell coupled-channel transition matrix, implying that the nuclear amplitude can be calculated within this model without any detailed information about the inelastic channels. We study this solution quantitatively for some model problems and for pion scattering, with the general result that inelastic shadowing can be significant whenever the elementary interaction has important channel coupling. For pion scattering in the energy regime characterized by strongly absorptive resonance, we find, for example, that the effect of inelastic shadowing is much more important than that due to two-nucleon correlations. (auth)

21773 ON THE VALENCE MODEL FOR RADIATIVE CAPTURE. Cugnon, J. (Institut de Physique Nucléaire, Division de Physique Théorique, 91406 Orsay, France); Mahaux, C. Ann. Phys. (N.Y.) 94: No. 1, 128-183 (19 Sept 1975).

We give several parametrizations for the elastic scattering and radiative capture cross sections for low neutron bombarding energy and discuss the relationship between the corresponding resonance parameters. We then perform an extensive investigation of the valence radiative capture model of Lane and Lynn. This model is formulated here in the

frame of the shell-model approach. We exhibit the similarities and differences between our results and those derived from the *R*-matrix approach by Lane and Lynn on the one hand and from the optical-model approach by Lane and Mughabghab on the other hand. Particular attention is paid to the choice of the average potential well in the shell model approach, in relation to the proper way to identify theoretical quantities and phenomenological parameters. We show that practically equivalent results can be obtained from a complex average potential well and from a suitably chosen real potential well, respectively. The following topic are investigated formally and numerically: dependence of the various theoretical expressions on the choice of the (real or complex) average potential well; relative importance of external and inertial capture; dependence of photon widths and background cross section on mass number (for thermal energy and for $E=100$ keV); dependence of the resonance parameters and background cross sections on energy, for $A=60$; comparison between experimental data and theoretical values for radiative capture on ^{56}Fe and ^{60}Ni. We discuss the conditions of validity of the valence capture model. In particular, we investigate the role of the giant dipole resonance and of the closed channels. We argue that the success of the valence capture model is intimately related to the importance of external capture. The contribution of the low-lying excited target states is investigated formally and numerically; it increases with mass number and tends to diminish the correlation between neutron and photon widths, which is implied by the valence capture model. (auth)

21774 NONEIKONAL APPROACH TO THE SCATTERING OF HADRONS FROM NUCLEI I. GENERAL THEORY. Gurvitz, S.A.; Alexander, Y.; Rinat, A.S. (Weizmann Institute of Science, Rehovot, Israel). Ann. Phys. (N.Y.) 93: No. 1, 152-192 (5 Sept 1975).

A procedure is given and utilized for the exact computation of multiple scattering amplitudes in the case of nonoverlapping, frozen, and singly struck target nucleons. Relaxing the condition of frozen scatterers, we essentially rederive the expressions mentioned above starting from relativistic Feynman diagrams which include the effect of nucleon recoil. By a heuristic procedure we also account for overlap and reflections to all orders. We show that all multiple scattering amplitudes thus calculated contain on-shell propagation parts close, but not identical, to their Glauber (eikonal) limits. Contributions due to off-shell propagation vanish in the eikonal limit, but constitute for finite energy and nonforward scattering angles the main corrections to this limit. The effect of the corrections in differential cross sections should be substantial in interference regions for low $|t|$, and for increasing $|t|$, in general. A numerical comparison among various predictions for the double scattering amplitude on a deuteron is given for a Gaussian wave function and Gaussian elementary amplitudes. (auth)

21775 COUPLING OF AN ODD PARTICLE TO A DEFORMED CORE. Das Gupta, S.; de Takacsy, N. (Physics Department, McGill University, Montreal, H3C 3GI Canada). Am. J. Phys. 44: No. 1, 47-50 (Jan 1976).

Band-mixing and decoupling factors are obtained for the coupling of an odd particle to a deformed core. The derivation avoids the use of commutation rules in a rotating frame and is easily generalized to more microscopic models of deformed nuclei. (auth)

21776 FACTORIZATION OF THE j equals $^7/_2$ SHELL OF NEUTRONS AND PROTONS. Transformation Coefficients to States of Good Particle Number. Kaminski, W. (Inst. of Physics, Lublin); Szpikowski, Z.; Hecht, K. T. At. Data Nucl. Data Tables; 16: No. 4, 311-381(Oct 1975).

Complete tabulations are given, for the j equals $^7/_2$ nuclear shell, of the transformation coefficients to states of good particle number needed in a new method of nuclear spectroscopy based on a quasi-particle factorization of the j-shell. The method leads to a classification scheme in which total angular momentum and isospin are good quantum numbers and in which the calculation of matrix elements can be carried out simply by standard techniques of Racah algebra, without the use of coefficients of fractional parentage and with the use of only a very small number of reduced matrix elements. These reduced matrix elements also are tabulated. A few sample calculations show how matrix elements of one- and two-body operators, single nucleon and pair creation operators, ..., can be calculated with this technique and the present tabulations. (auth)

21777 ODD MASS NUCLEI: THE EQUATIONS OF MOTION AND ANGULAR MOMENTUM PROJECTION. Laucks, S. P. Jr. Bethlehem, PA; Lehigh Univ. (1975). 111p. University Microfilms Order No. 75-23,998.

Thesis (Ph. D.).

The spectra of medium-heavy odd mass nuclei are calculated using the pairing plus quadrupole-quadrupole Hamiltonian and the equations-of-motion method. The even-even nucleus is described by the projected angular momentum technique where the intrinsic state is taken to be proportional to an exponential in two quasi-particle excitations. The relative weights of the various two quasi-particle excitations are found by a variational method. The equations of motion are non-linear, and the linearization of them gives rise to a number of spurious solutions. Two techniques for eliminating the spurious results are demonstrated. These methods rely on the specifics of the even nucleus model. These techniques are applied to a number of odd mass nuclei with good results. (Diss. Abstr. Int., B)

21778 RELATIVISTIC SUPERDENSE MATTER IN COLD SYSTEMS: THEORY. Bowers, R.L. (Department of Physics, Texas A& M University, College Station, Texas 77843); Gleeson, A.M.; Pedigo, R.D. Phys. Rev. D 12: No. 10, 3043-3055 (15 Nov 1975).

The extension of relativistic quantum fields to dense systems of fermions strongly interacting via meson exchange is discussed. The direct application of quantum field theory methods in this context fails. The failure of this approach leads to an effective Lagrangian based on an approximation scheme naturally suited to high-density matter. The resulting model can be solved exactly for cold systems, and small temperature corrections may be added. The applications of this model to neutron stars and problems in elementary physics will be made in the following paper. (auth)

21779 UNITARITY CONDITIONS FOR THE KAPUR–PEIERLS EXPANSION. Adler, D. B.; Adler, F. T. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 669-670(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21780 BEHAVIOR OF THE AMPLITUDE OF NUCLEON–NUCLEON SCATTERING OFF THE ENERGY SURFACE. Vaskin, A. I.; Zhurina, M. I.; Novozhilova, V. N.; Popova, A. M. (Moscow State Univ.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 125-128(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 144-147(1975).

A discussion is given of the calculation of N–N scattering amplitudes using various potentials. The results of the calculations demonstrate a fairly strong sensitivity of the amplitude to the form of the chosen interaction but not to the variation of those parameters of a certain form of the potential which yield good agreement between the theoretical phases and the experimental ones. Under these conditions it follows that at lower energies the dependence on the parameters of the potential is stronger. (auth)

21781 CONSIDERATION OF THE PAULI PRINCIPLE IN THE OPTICAL AMPLITUDES OF SCATTERING OFF THE MASS SURFACE. Krasnopol'skii, V. M.; Kukulin, V. I. (Moscow State Univ.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 129-133 (1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 148-152(1975).

Three procedures are investigated for excluding the contribution from occupied states to the optical scattering amplitudes off the mass surface. It is shown that the use of the Bethe-Goldstone method and the Gilbert-Schmidt basis, although it does allow pronounced reduction of the magnitude of the eigenvalues of the Gilbert-Schmidt kernels corresponding to the occupied states, it nevertheless also changes the scattering amplitude on the mass surface greatly in the general case. Conversely, the transition to pseudopotentials which include the projectors onto occupied states leads to practically complete exclusion of the contribution of these states from the t-matrix off the mass surface, so that the renormalized potentials, t-matrices and corresponding Green's functions may serve as a convenient basis for performing many-particle dynamic calculations of nuclear reactions either on the basis of three-particle theory of deuteron nuclear reactions (stripping, pickup, etc.) or on the basis of the Faddeev equations or variational technique. (auth)

21782 MOMENTUM DIAGRAMS FOR THREE-PARTICLE NUCLEAR REACTIONS. Kosinov, G. A.; Lagutin, I. G.; Lyubinskii, N. N.; Nemets, O. F. (Inst. of Nuclear Research, Kiev). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 134-138(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 153-157(1975).

In connection with the fact that the momentum diagram of a reaction involving the formation of three particles may be represented in the form of a combination of diagrams for two-particle reactions, certain fundamental concepts used in constructing such diagrams are recalled.

21783 CONCERNING SYMMETRICAL FEW-NUCLEON REACTIONS. Komarov, V. V. (Moscow State Univ.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 139-141(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 158-160(1975).

The development of the theory of the scattering of several nonrelativistic particles which is based on rigorous integral equations for the amplitudes of the interactions in the system of these particles currently allows the development of a certain general approach to an investigation of few-nucleon nuclear reactions, including symmetrical reactions. A certain few-nucleon nuclear reaction is represented as a "many-particle" scattering process involving n particles in the general case. An attempt is made to find particular solutions of the resulting equations in analytic form. (auth)

21784 CONTRIBUTION OF THE ONE-BOSON EXCHANGE POTENTIALS TO THE POTENTIAL OF SCATTERING OF ANTINUCLEONS BY NUCLEI. Savushkin, L. N. (Leningrad State Univ.). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 147-150 (1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 167-171(1975).

Consideration is given to a procedure for constructing the optical potential (more precisely, its real and spin-orbital parts) on the basis of modern concepts of nucleon-nucleon interaction which are associated with the one-boson exchange potentials (OBEP) that were used to describe the scattering of nucleons by one another in a very wide range of nucleon energies and deuteron properties. (auth)

21785 EFFECT OF THE MAGNETIC MOMENT OF A NUCLEUS ON THE INTERNAL CONVERSION COEFFICIENTS. Shulyakovskii, G. S. Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 151-155(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 172-176(1975).

A detailed calculation has been performed in order to investigate the effect of the interaction of the magnetic moment of the nucleus and a shell electron on the magnitude of the internal conversion coefficients (ICC). The calculation was carried out without allowance for screening. It is shown that the magnetic moment of a nucleus may change the magnetic ICC on the M_{I-III} subshells of an atom by 0.7% for multipole orders L = 1,2 and transition energies K = 0.1 to 1 (MoC^2). (SDF)

21786 IMPORTANCE OF DELAYED FISSION IN THE PRODUCTION OF VERY HEAVY AND SUPERHEAVY ELEMENTS. Wene, C. O.; Johansson, S. A. E. (Univ. of Lund, Sweden). Phys. Scr.; 10A: 156-162(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

Recent advances in the calculation of fission barriers and in the experimental determination of β strength functions make it possible to derive reliable estimates of the effect of β- delayed fission in the decay of very heavy nuclides far from the line of β-stability. The model presented here is used to calculate the amount of delayed fission during the decay back of nuclides produced in the intense neutron burst from a nuclear explosion and of nuclides produced in the astrophysical r-process. An interesting feature of these calculations is that they reproduce the reversal of the odd–even effect found for the yield of β-stable nuclides obtained in the thermonuclear explosions. The preliminary results from the r-process calculations indicate that the effect of delayed fission has to be considered when the yield of very heavy β stable nuclides from this process is estimated. (5 figures, 2 tables) (auth)

21787 DISAPPEARANCE OF SHELL EFFECTS AT HIGH EXCITATION. Self-consistent Calculations at Finite Temperatures. Brack, M.; Quentin, P. (Univ. of Copenhagen). Phys. Scr.; 10A: 163-169(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

Self-consistent calculations of highly excited nuclei are presented. The changes in the average nuclear field as a function of temperature are discussed; they are found to be negligible in the calculation of the entropy versus excitation energy at a fixed deformation. The disappearance of shell effects at temperatures $T \simeq 2-3$ MeV in heavy nuclei is demonstrated both by calculations of deformation energy curves at different temperatures and by considering the asymptotic behavior of the entropy. Finally, the validity of some simplifying approximations is discussed. (8 figures, 2 tables) (auth)

21788 CHANGE OF THE VACUUM IN SUPERHEAVY QUASIMOLECULE. Mueller, B.; Greiner, W. (Univ., Frankfurt am Main). Phys. Scr.; 10A: 170-174(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

In collisions of very heavy ions ($Z_1 + Z_2 > 172$) molecular electronic orbitals are formed. Generalized Hartree-Fock equations for this case are derived from field theoretic principles. It is shown that the lowest ground state (i.e. the vacuum) becomes charged for $Z > Z_{cr}$ and $R < R_{cr}$. If the K-shell is vacant, positron production sets in. The energy distribution of the positrons and the cross-section for this process are calculated. (7 figures) (auth)

21789 RECENT EXPERIMENTAL RESULTS FROM SPECTROSCOPY OF SUPERHEAVY QUASIATOMS. Armbruster, P. (GSI, Darmstadt, Ger.); Kraft, G.; Mokler, P.; Fricke, B.; Stein, H. J. Phys. Scr.; 10A: 175-182(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The concept of a "Superheavy Quasiatom" is discussed. Radiative transition times are compared with the lifetime of the intermediate system, cross sections are calculated within a two-collision model and induced transitions and their anisotropic emission are discussed. Recent experimental and theoretical results are presented from collision systems obtained with I-beams bombarding various heavy targets, giving combined Z-values between 120 and 145. Results include the energy dependence of the peak structure interpreted as M X-rays from superheavy quasiatoms and the anisotropy of X-ray emission referred to the beam direction. The data are discussed within the models available. These cannot explain the strong emission of anisotropic radiation in the X-ray energy range of quasiatomic M X-rays at small bombarding energies. (1 table, 11 figures) (auth)

21790 NUCLEAR CAPTURE OF K^- MESONS. Goel, S. P. (Univ., Kurukshetra, India); Prakash, Y. Indian J. Pure Appl. Phys.; 13: No. 5, 307-315(May 1975).

The nuclear capture of K^- mesons in emulsion nuclei is studied through computer simulation. Information on the energy distribution of emitted protons, momentum distribution of outgoing Λ° hyperons, nuclear excitation energy and some features of the K^- capture star, is presented. The results of this study indicate that proton energy spectrum can be used to separate single and two nucleon K^- captures. Recoil is not found to be a reliable criterion to separate K^- captures in light and heavy nuclei. (auth)

21791 SOME CURRENT THEMES IN NUCLEAR RESEARCH. Bohr, A. (Univ. of Copenhagen); Mottelson, B. R. Phys. Scr.; 10A: 13-20(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The topics covered include: (a) elementary modes of excitation with special emphasis on the isoscalar high-frequency quadrupole vibrations; (b) conditions for shell structure in both spherical and deformed potentials; (c) modifications in nuclear structure produced by large angular momentum, including a discussion of stability conditions as well as of the spectrum of quantum states in the yrast region for very large angular momentum. (11 figures) (auth)

21792 MANY-BODY THEORY AND OBSERVED SINGLE PARTICLE LEVELS. Koehler, H. S. (Univ. of Arizona, Tucson). Phys. Scr.; 10A: 81-83(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

It is emphasized that the single-particle levels calculated from a shell model potential are physically meaningful only if the shell model potential is calculated in a self-consistent Hartree-Fock manner. Rearrangement corrections to the single-particle levels calculated in this fashion are small for atoms. For nuclei there is experimental evidence that these corrections are quite large. One of these corrections is the 1h–2h1p coupling that shifts single-particle levels close to the Fermi surface up and gives a decay (Auger decay) width to the deeper states. (2 tables, 1 figure) (auth)

21793 CLASSICAL TREATMENT OF HEAVY-ION COLLISIONS. Sperber, D. (NORDITA, Copenhagen). Phys. Scr.; 10A: 115-117(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

Heavy ion reactions high above the Coulomb barrier are analyzed by using a classical model with dissipative forces. It is shown, in agreement with experiment, that the reaction can be divided into three parts: (1) quasielastic scattering, associated with high-angular momenta, (2) deep inelastic scattering, with intermediate angular momenta, and (3) complete fusion associated with the lowest angular momenta. Good agreement between theory and experiment is obtained for the cross section for complete fusion and for the cross section for deep inelastic scattering. (3 figures, 2 tables) (auth)

21794 ROLE OF INERTIAL PARAMETERS IN NUCLEAR FISSION. Szymanski, Z. (Institute for Nuclear Research, Warsaw). Phys. Scr.; 10A: 122-126(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The properties of the nuclear tensor of inertia are discussed in connection with the fission process. In particular, the relations between the nuclear inertial parameters and the characteristics of the nuclear intrinsic motion are considered. (3 tables, 6 figures) (auth)

21795 QUANTUM MECHANICAL MOTION IN A MULTI-DIMENSIONAL SPACE OF DEFORMATION (BARRIER PENETRATION). Pauli, H. C. (Max-Planck-Institut fuer Kernphysik, Heidelburg). Phys. Scr.; 10A: 127-131(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

In the first part, calculated lifetimes for spontaneous fission from the ground and from the isomer state are presented. The agreement reached with experiments corresponds to the crude approximations done, but is better than expected. The calculations are based on the shell correction approach for the potential energy and on the cranking model for the collective mass. In the second part we discuss the behavior of the so-called least action trajectories: there are two of them, one for symmetric and one for asymmetric shapes. The systematic behavior of the dynamic barriers and of the peak-to-peak ratio of the fission fragment mass distribution and their correlation with the experimental information support this point of view. (6 figures) (auth)

21796 HADRON-NUCLEUS COLLISIONS AT HIGH ENERGIES. Koplik, J.; Mueller, A.H. (Department of Physics, Columbia University, New York, New York 10027). Phys. Rev. D 12: No. 11, 3638-3665 (1 Dec 1975).

We discuss high-energy hadron-nucleus scattering in terms of model in which the basic hadron-hadron interaction is due to the exchange of Regge poles and cuts. Much of the paper uses a configuration-space description in which the time scales of interactions are of critical importance, although equivalent results may be obtained in momentum space. We study in detail the general behavior of elastic, total, and inclusive cross sections, the relevance of the Glauber expanison, and the influence of Regge cuts and interactions. Most of the discussion is based on the softened-field-theory model of Reggeons, although we also consider the contrasting planar dual string model and show how one may experimentally distinguish between models of these two types. (auth)

21797 STATISTICAL PROPERTIES OF EXCITED FISSIONING NUCLEI. Kapoor, S. S.; Ramamurthy, V. S. (Bhabha Atomic Research Centre, Bombay). Pramana; 5: No. 3, 124-143(Sep 1975).

The phenomenon of the disppearance of the shell effects on the thermodynamic properties of nuclei with increasing excitation energy has been examined quantitatively on the basis of numerical calculations based on realistic shell model single particle level schemes. It is shown that shell effects disappear at moderate excitation energies and above these excitation energies, the thermodynamic behavior of the nucleus is identical to that of the equivalent liquid drop model nucleus. Implications of the above feature in the interpretation of some aspects of fission of excited nuclei such as mass-asymmetry and angular anisotropy are examined. The relationship of the phenomenon of washing out of shell effects at high excitation energies with the temperature smearing method of determining ground state shell correction energies is also outlined. (11 figures) (auth)

21798 SOME CONVERGENCE PROPERTIES OF THE PERTURBATION SERIES FOR THE EFFECTIVE NUCLEAR INTERACTION: THE STABILITY OF RESULTS UNDER DOUBLE PARTITIONING IN MASS 18 NUCLEI. Herbert, F. L. Tucson, AZ; Univ. of Arizona (1975). 70p. University Microfilms Order No. 75-19,587.

Thesis (Ph. D.).

The Bloch-Horowitz-Brandow (BHB) expansion for the effective interaction in mass-18 nuclei was evaluated by the method of double partitioning. That is, the BHB expansion for the effective interaction was divided into two calculations for the purpose of approximating separately the high- and low-energy (long- and short-range, respectively) effects so as to improve the approximation of each. This was done by approximating a high-energy effective interaction (for a larger, or "outer," model space) and then using that for the potential in terms of which the low-energy BHB expansion (for a smaller, or "inner," model space: the sd shell) is evaluated. The size of the outer model space was 4 dirac constant OMEGA (OMEGA being the frequency of the harmonic-oscillator potential defining the basis) larger than the smaller. A second calculation of the same type was done with an outer model space two major shells larger than the inner model space. The results, by comparison with earlier work by Barrett, show a trend that suggests that the (intermediate-range) tensor force is being poorly accounted for and as a result the convergence of the intermediate-excitation sums is poor, a finding similar to that found by Vary, Sauer and Wong. The convergence of the order-by-order sum, however, seems to be improved as the outer model space is enlarged. The suggestion is made that the use of a better approximation, if one can be found, to the effective interaction for the outer model space (appropriate for including the effects of the tensor force) might improve the intermediate-excitation convergence. (Diss. Abstr. Int., B)

21799 TEST OF THE SHELL MODEL APPROACH TO NUCLEAR REACTION THEORY USING A ONE-DIMENSIONAL THREE-BODY SYSTEM. Rodjak, D. J. Cleveland; Case Western Reserve Univ. (1975). 139p. University Microfilms Order No. 75-19,241.

Thesis (Ph. D.).

A model calculation is performed to test new formalisms for discretizing the continuum of three-body breakup channels and for evaluating the three-body Green's function. The model consists of three, equal-mass, spinless, distinguishable particles interacting with each other via delta function potentials and constrained to move in one-dimension. The simplicity of this system enables the study of the difficulties caused by the presence of breakup and rearrangement channels. In addition, results are compared to the exact answer for the symmetric potential case and to the Faddeev theory results for a non-symmetric potential case. The procedure for discretizing the continuum was found to be numerically practical. The transition probabilities converged rapidly and smoothly as more discrete levels were used to approximate the continuum. The calculated results were physically consistent with predictions of the spectator model. It was found that the distorted-wave Born approximation (DWBA) K-matrix gave better results than the DWBA T-matrix. Equations are developed for the three-body Green's function that include all the asymptotic boundary conditions and that remove disconnected graphs from the kernels of the coupled integral equations. (Diss. Abstr. Int., B)

21800 THOMAS–FERMI MODEL OF THE NUCLEUS WITH SEPARABLE NON-LOCAL POTENTIALS. Wheeler, D. J. New York; Fordham Univ. (1975). 117p. University Microfilms Order No. 75-18,933.

Thesis (Ph. D.).

The Thomas-Fermi model is adapted to the case in which the potential is assumed to be non-local and separable. Specifically, the Thomas-Fermi model as formulated by Lenz and Jensen is employed, and the nucleon-nucleon interaction is taken to be the Tabakin potential, which is a separable, non-local, translation invariant potential with a soft core. An expression for the total energy of the many nucleon system is given as formulated by Szasz and Schroeder. The Hartree-Fock equations are obtained by neglecting correlations in the total wavefunction and then minimizing the energy with respect to the single-particle wavefunctions. The Tabakin potential is described in detail, and the Hartree-Fock energy expression with the Tabakin potential is evaluated by utilizing the techniques of Lenz and Jensen. All sums over momentum states are replaced by integrations over the Fermi sphere, and the Fermi momentum is shown to be simply related to the nucleon density. The energy thus becomes a function of density and can be minimized with respect to it. The Coulomb and Coulomb exchange energies are included in the energy expression. Expressions for each as functions of nucleon density are obtained, thus making possible minimization of the total energy with respect to the density. The density is assumed to be Gaussian in form, and a single variational parameter is included. The program for numerical minimization with respect to this parameter is described. The results of calculations of the binding energy per particle of eight magic number nuclei are presented and evaluated. (Diss. Abstr. Int., B)

21801 THOMAS–FERMI MODEL OF THE NUCLEUS WITH THE WEIZSAECKER INHOMOGENEOUS CORRELATION TERM USING A SEPARABLE NON-LOCAL POTENTIAL. Yumol, R.B. New York; Fordham Univ. (1975). 149p. University Microfilms Order No. 75-18,934.

Thesis (Ph. D.).

The Thomas-Fermi model is applied to the nucleus using a potential which is separable and non-local. The Lenz-Jensen formulation is employed and the nucleon-nucleon interaction used is taken to be the Tabakin Potential. The correlation effects were neglected in the total wave functions and the energy is minimized with respect to single particle functions. The Thomas-Fermi model is presented as an alternate to the Hartree-Fock method. A correction due to Weizsaecker is introduced into the model. The need for the reduction of this correction term is shown. A reduction factor was likewise introduced for the kinetic energy as well as the Weizsaecker correction term and the effect to these two reduction terms on the energy and the density is investigated. The Tabakin potential is described in detail and is then approximated by an analytical expression. The total energy is expressed as a function of the density and is minimized relative to the density. The method of Lenz and Jensen is used wherein the density is written as a parameterized function and the energy is minimized relative to the parameters of the density. The density used is the Fermi density obtained by Hofstadter. This density contains two parameters. The minimization method relative to two parameters is described. A reduction

factor of one-fourth is found to be needed to give results which when used with the second order results give close values to the experimental energy. It was likewise found that only the Weizsaecker correction term needed the reduction factor and not the kinetic energy term. The results of the calculations of the binding energy with the Weizsaecker reduction factor equal to one-fourth for eight nuclei are presented and evaluated. (Diss. Abstr. Int., B)

21802 CONTRIBUTION TO A MICROSCOPIC APPROACH TO THE REAL PART OF THE OPTICAL POTENTIAL. Munro, J. K. Jr. Lexington, KY; Univ. of Kentucky (1974). 166p. University Microfilms Order No. 75-18,499.

Thesis (Ph. D.).

A microscopic model is presented as a basis for justifying two terms in the complex optical model potential (COMP): the real central term and the real spin-orbit term. The projectile type is restricted to neutrons which are elastically scattered at low energies from the target. The model uses the no-polarization approximation and is formulated in the projection operator language used by Feshbach. The operator P, which projects the elastic scattering component out of the total system wave function, is constructed and shown to be well-defined, both for correlated and uncorrelated target wave functions. The uncorrelated target wave functions are represented by Slater determinants of the target single particle states. Expressions for the direct and exchange contributions to the real central and spin-orbit terms in the COMP are given in terms of a two-body interaction and the target single particle states. The equivalent local potential (ELP) method of Coz, Arnold and MacKellar is used to compute a local potential equivalent to the non-local exchange contribution arising from antisymmetrication of the (A + 1)-particle wave function. Effective interactions are considered more appropriate for the model than realistic interactions since effective interactions take into account correlations between two interacting nucleons due to the presence of other neighboring nucleons. Numerical calculations were restricted to the real central term of the COMP for neutrons scattering from an ^{16}O target. Both two-body effective interactions used give repulsive direct potentials. A study was made of how each subshell in the target contributes to the direct potential. The realistic interaction with cut-off at the separation distance produces attractive direct potentials. In the two cases where the effective interactions produced repulsive direct potentials, the exchange potentials were sufficiently attractive for all values of the radius. (Diss. Abstr. Int., B)

21803 ENERGY DEPENDENT SEPARABLE APPROXIMATION TO LOCAL POTENTIALS. Yang, K. H. Amherst, MA; Univ. of Massachusetts (1975). 117p. University Microfilms Order No. 75-27,561.

Thesis (Ph. D.).

Excellent fits to on-shell t-matrix elements of a realistic local potential are obtained using a single-term energy-dependent separable potential in each of five channels. The comparison of half-off-shell t-matrix elements is also very favorable. The optical potential used contains absorption as well as spin-orbit contributions and is appropriate for the low energy n-^{27}Al system. The separable potential is constructed so as to have the correct t-matrix pole locations and residues in each of the five channels. The ability of the separable potential in generating the full-off-shell behavior of the exact T-matrix is hindered by the nature of the single-term separable form. Application to the p-^{27}Al optical potential gives similar results. (Diss. Abstr. Int., B)

21804 NUCLEAR COLLISIONS WITH FRICTION. Tsang, C. F. (Univ. of California, Berkeley). Phys. Scr.; 10A: 90-93 (1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

A theory of nuclear collisions where a frictional force is introduced explicitly from the beginning is worked out based on a macroscopic and leptodermous idealization. A solution of the problem is made by freezing all degrees of freedom but four: the distance between centers of the colliding nuclei, the angle of rotation of a line joining the centers and the two angles measuring the spins of the nuclei. The condition for capture as a function of energy and angular momentum is discussed in detail. Results on the kinetic energy and angular distributions of collision products are also obtained. 5 figures. (auth)

21805 STABILITY OF ELEMENT IN THE r-PROCESS REGION. Bengtsson, R. (Lund Inst. of Tech., Sweden); Boleu, R.; Larsson, S. E.; Randrup, J. Phys. Scr.; 10A: 142-148(1974).

From 20th Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The fission barriers of the nuclei in the r-process region have been calculated with inclusion of axial asymmetry and reflection asymmetry. Neutron separation energies and spontaneous-fission half-lives have been calculated and the possibilities of producing superheavy elements by means of neutron-capture processes are discussed. 12 figures. (auth)

21806 NUMBER OF REGULARITIES IN THE COLLISION OF RELATIVISTIC NUCLEI. Baldin, O. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Dokl. Akad. Nauk SSSR; 222: No. 5, 1064-1067(11 Jun 1975). (In Russian)

Regularities in nuclear fragmentation are considered which can be followed by methods of track counting. The main regularities which were noted are: the interaction cross section of nuclei I and II can be broken down into multipliers depending only on the properties of nuclei I and II; the average velocities of the fragments are equal to the velocity of the incident nucleus, and the momentum distribution has the form of a succession of peaks (maxima), and the momentum distributions of the fragments are identical in a coordinate system, where the fragmenting nucleus is at rest. The longitudinal momentum distribution is the same as the radial momentum distribution, and has a Gaussian form. If the reaction goes through a single-particle intermediate state, it is shown that the relativistically invariant cross section can be factored into multipliers, one of which describes the process $I \rightarrow 1 + 2$, and the other multiplier describes the collision of particles 2 and II. The introduction of a single parameter in place of longitudinal and radial momenta simplifies the analysis. A model is formulated that predicts narrow momenta distributions and the region of cumulative particle formation. A classification is proposed for the collision of relativistic nuclei. (SJR)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 20271, 20289, 20383–20393, 20875, 21111, 21112, 21161, 21578, 21838, and 21844.

21807 SPATIAL DISTRIBUTION OF ENERGY DEPOSITED IN NITROGEN BY ELECTRONS. Barrett, J.L.; Hays, P.B. (Space Physics Research Laboratory, Department of Atmospheric and Oceanic Science, The University of Michigan, Ann Arbor, Michigan 48105). J. Chem. Phys. 64: No. 2, 743-750 (15 Jan 1976).

The spatial distribution of the energy deposited by kilovolt electrons moving through gaseous molecular nitrogen was measured. The range of electrons of initial energy 300 eV to 5 keV was obtained and can be expressed by the formula $R=K_1+K_2E^{A1}-K_3E^{A2}$, where R is the range, E is the initial energy of the electrons, and K_i,A_i are constants. The range, in this energy interval, is greater than that determined by previous measurements. A source of error, not previously discussed, is considered. The energy region (above 1 keV) where the simpler expression $R=KE^4$ holds is discussed. It is shown that this is the energy region where the energy and range dependence of the energy deposition curve can be removed and a normalized, characteristic energy deposition curve λ can be obtained. The efficiency of conversion of electron energy at 1 keV and 280 μ pressure to energy of photons at 3914 Å was measured to be (0.28 ± 0.03)%. (auth)

21808 ENERGY LOSS OF MeV α PARTICLES IN THE PALLADIUM-HYDROGEN SYSTEM IN PLANAR CHANNELING. Pathak, A.P. (Section d'Etude des Solides Irradiés, Centre d'Etudes Nucléaires de Fontenay-aux-Roses, Fontenay-aux-Roses 92260, France). Phys. Rev. B 13: No. 1, 461-463 (1 Jan 1976).

The energy loss of MeV α particles moving between (111) planar channels of the palladium-hydrogen system has been calculated for the case when the hydrogen-atom concentration is only a few at.% (α phase). The contribution due to additional electrons of hydrogen atoms is estimated by assuming that these go to the 4*d* band, and that due to protons is obtained by considering α-particle-proton scattering. The proton contribution is found to be very small compared to that due to additional electrons for well-channeled particles, which itself is about 0.001*x* of the electronic stopping power in the (111) planar channel for pure Pd, *x* being the atomic percentage of H in Pd. (auth)

21809 MULTIGROUP NEUTRON TRANSPORT. I. FULL RANGE. Bowden, R.L.; Sancaktar, S. (Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061); Zweifel, P.F. J. Math. Phys. (N.Y.) 17: No. 1, 76-81 (Jan 1976).

A functional analytic approach to the *N*-group, isotropic scattering, particle transport problem is presented. A full-range eigenfunction expansion is found in a particularly compact way, and the stage is set for the determination of the half-range expansion, which is discussed in a companion paper. The method is an extension of the work of Larsen and Habetler for the one-group case. (auth)

21810 MULTIGROUP NEUTRON TRANSPORT. II. HALF RANGE. Bowden, R.L.; Sancaktar, S. (Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061); Zweifel, P.F. J. Math. Phys. (N.Y.) 17: No. 1, 82-86 (Jan 1976).

This paper accompanies a preceding one in which a functional analytic method was used to obtain the full-range expansion in multigroup neutron transport. In the present paper the analysis is extended to obtain the half-range expansion. The method used is an extension of the work of Larsen and Habetler for the one-group case. The results are given in terms of certain matrices which are solutions of coupled integral equations and which factor the dispersion matrix. (auth)

21811 ENERGY DEPOSITION OF SUPERPINCHED RELATIVISTIC ELECTRON BEAMS IN ALUMINUM TARGETS. Perry, F.C.; Widner, M.M. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 47: No. 1, 127-134 (Jan 1976).

Dynamic response data, which traditionally have been used to obtain equation-of-state (EOS) information of materials, were instead used here to study energy deposition of an intense ($\sim 10^{11}$ W/cm^2) tightly focused relativistic electron beam (REB). Measurements of the REB-induced shock-wave transit time and average rear-surface velocity were compared with two-dimensional hydrodynamic calculations which contain well-known EOS information for 6061-T6 aluminum. The experimental results were consistent with classical electron deposition, i.e., a one-dimensional Monte Carlo transport calculation. In addition, peak pressures in the range 1–2 Mbar (0.1–0.2 TPa) were implied. Two anomalous effects were observed: (i) a low-amplitude (free-surface velocity $\sim 10^4$ cm/sec) precursor signal, preceding the REB-induced shock wave and (ii) a velocity distribution of material behind the rear surface of the target following the arrival of the REB-induced shock wave. (auth)

21812 CHARGE EFFECTS ON THE RADIATIVE DECAY OF X-RAY IONS. Model Calculations for Some Transition Metals. Gianturoco, F. A.; Simprini, E.; Stefani, F. (CNR, Pisa, Italy). Inorg. Chem.; 14: No. 12, 2890-2895(Dec 1975).

The effect of perturbed valence-shell populations on the energies associated with radiative decays following X-ray ionization is examined and the relevant shifts are computed within the "free ion" model for the transition metal series. The different terms contributing to the emitted photon energies are examined for K alpha 1,2, K beta 1,3, K beta 5, and LM fluorescence lines and their relative importance is discussed. The different trends in "chemical" shifts exhibited by the K alpha 1,2 and other emission channels when varying the number of 3d and 4s electrons in the valence shells are computed and explained within the framework of simplified, local interaction potentials. (auth)

21813 INELASTIC-INTERACTION MEAN FREE PATH OF NEGATIVE PIONS IN TUNGSTEN. Cheshire, D.L.; Huggett, R.W.; Jones, W.V.; Rountree, S.P. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803); Schmidt, W.K.H.; Kurz, R.J.; Bowen, T.; DeLise, D.A.; Krider, E.P.; Orth, C.D. Phys. Rev. D 12: No. 9, 2587-2593 (1 Nov 1975).

The inelastic-interaction mean free paths λ of 5-, 10-, and 15-GeV/*c* pions have been measured by determining the distribution of first-interaction locations in a modular tungsten-scintillator ionization spectrometer. In addition to commonly used interaction signatures of a few (2–5) particles in two or three consecutive modules, we have used a χ^2 distribution to calculate the probability that the first interaction occurred at a specific depth in the spectrometer. This latter technique seems to be more reliable than use of the simpler criteria. No significant dependence of λ on energy has been observed. In tungsten, λ for pions is 206 ± 6 g/cm^2. (auth)

21814 STOPPING POWER OF NICKEL FOR FISSION FRAGMENTS: Z_1. Bucher, R. G.; Wehring, B. W. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 151-152(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21815 MONTE CARLO SPLITTING SURFACE IDENTIFICATION BY PATTERN RECOGNITION. Macdonald, J. L. (Los Alamos Scientific Lab., NM); Koen, B. V.; Cashwell, E. D. Trans. Am. Nucl. Soc.; 22: 281-282(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21816 APPLICATION OF THE MULTIPLE REACTION NEUTRON DOSIMETRY METHOD TO A FUSION REACTION ENVIRONMENT. Odette, G. R. (Univ. of California, Santa Barbara). Trans. Am. Nucl. Soc.; 22: 803-804(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21817 INITIAL RADIATION DOSE DISTRIBUTIONS ACROSS TYPICAL VILLAGES. II. Calculational Results. Cohen, M. O. (MAGI, Elmsford, NY). Trans. Am. Nucl. Soc.; 22: 811-812 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21818 METHOD FOR PROCESSING ENDF/B PHOTON FORM FACTOR DATA. Lucius, J. L.; Greene, N. M. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 819-820(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21819 "W" VALUE FOR CYCLOTRON NEUTRONS. Glenn, D. W. Houston, TX; Univ. of Texas Health Science Center (1975). 101p. University Microfilms Order No. 75-20,516.

Thesis (Ph. D.).

A study was made of the design, fabrication, and measurements of a tissue-equivalent calorimeter which was compared with a tissue-equivalent ionization chamber filled with tissue-equivalent gas when exposed to a cyclotron beam. The measurements resulted in a value of W of 31.0 ± 0.8 eV/ion pair. This value is within a few percent of theoretical calculated values and the value presently used in United States by neutron radiotherapy groups. (Diss. Abstr. Int., B)

21820 ENERGY LOSS OF ELECTRONS IN NITROGEN. Barrett, J. L. Ann Arbor, MI; Univ. of Michigan (1975). 83p. University Microfilms Order No. 75-20,290.

Thesis (Ph. D.)

The spatial distribution of the energy deposited by kilovolt electrons moving through gaseous molecular nitrogen was measured.

The range of electrons of initial energy 300 eV to 5 keV was obtained and can be expressed by the formula: R equals $K_1 + K_2E/sup A_1/ - K_3E/sup A_2/$. The range, in this energy interval, is greater than that determined by previous measurements. The energy region (above 1 keV) where the simpler expression R equals KE/sup A/ holds is discussed. It is shown that this is the energy region where the energy and range dependence of the energy deposition curve can be removed and a normalized energy deposition curve, lambda, can be obtained. The efficiency of conversion of electron energy at 1 keV and 280 mu pressure to energy of photons at 3914 A was measured to be (0.28 +- 0.03) percent. (Diss. Abstr. Int., B)

21821 TRANSPORT AND ENERGY LOSS EFFECTS OF CHARGED PARTICLES IN EMULSION RADIATION DETECTORS. Vols. I and II. Flynn, M. J. Ann Arbor, MI; Univ. of Michigan (1975). 362p. University Microfilms Order No. 75-20,344.

Thesis (Ph. D.).

The results of investigations into the basic physical processes involved in the exposure of film to charged particles are reported, and analytic models for the qualitative description of the response characteristics of emulsion radiation detectors are presented. The response of emulsions to charged particles is examined by deriving formulae to predict the number of silver bromide grains sensitized per unit pathlength of a charged particle with a given energy. The Barkas model is used to analyze the sensitization of grains which are penetrated by the primary particle and the contribution to grain production from recoil electrons is predicted by an original analytic expression. An analysis of charged particle transport describes the effects of energy straggling by equations of the Gaussian pathlength probability type, and the effects of multiple scattering by expressions based on the Fokker Planck approximation to the transport equation. A numerical transport algorithm is presented which compromises accuracy and numerical speed to provide a description of intermediate complexity and broad versatility. (Diss. Abstr. Int., B)

21822 DETERMINATION OF DEPTH-DOSE DISTRIBUTIONS FROM COBALT-60 GAMMA BEAMS BY SMALL VOLUME SCATTER SUMMATION. Dean, R. D. Lawrence, KS; Univ. of Kansas (1975). 119p. University Microfilms Order No. 75-26,381.

Thesis (Ph. D.).

A study has been made to determine the scattered dose distribution within and around a 1 cubic centimeter scattering kernel that was exposed to a monodirectional beam of 1.25 MeV gamma rays. The study is limited to water as the scattering medium. One experimental method utilized a direct measurement of the scattered dose with LiF thermoluminescent dosimeters held in a fixed array. A collimated pencil beam of ^{60}Co gamma rays was directed through a hollow tube within a water phantom. A stack of 20 LiF-Teflon TLD's was placed in the beam to monitor the absorbed energy from the beam and to act as the scatterer. The second approach involved performing a Monte Carlo simulation of the ideal experimental situation. A total of 100,000 photon histories were followed after each had interacted within a 1 cubic centimeter water scatterer. An accompanying study of the radiation distribution across a 2.0 cm diameter ^{60}Co source contained in AECL Theratron 80 was performed. A 1.0 mm slit collimator was used instead of the more commonly used circular "pinhole" collimator. (Diss. Abstr. Int., B)

21823 SILICON IONIZATION AND DISPLACEMENT KERMA FOR NEUTRONS FROM THERMAL TO 20 MeV. Rogers, V. C.; Harris, L. Jr.; Steinman, D. K.; Bryan, D. E. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2326-2329 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Displacement and ionization kerma calculations have been performed for silicon using cross sections from the ENDF/B Version IV MAT 1194 evaluation. Kerma were calculated by the code KMART, which is an extension of the MACK code. The present ionization results are in excellent agreement with recent measurements. (auth)

21824 X-RAY PHOTOEMISSION CALCULATIONS. Chadsey, W. L.; Wilson, C. W.; Pine, V. W. (Science Applications, Inc., McLean, VA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2345-2350 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Results are presented from an extensive parametric study of x-ray photoemission. Calculations were performed of fore and back emission yield and energy-angular distribution, including the two-dimensional, asymmetric angular distribution for non-normal photon incidence, for a broad range of photon energies, angles of incidence, and material atomic numbers. Monte Carlo and analytical calculations are compared with one another and with experimental data. A new Monte Carlo method is presented which makes feasible the calculation of the two-dimensional angular distribution and yields a continuous representation of the distribution in functional form. (auth)

21825 COUPLED ELECTRON/PHOTON TRANSPORT IN STATIC EXTERNAL MAGNETIC FIELDS. Halbleib, J. A. Sr.; Vandevender, W. H. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2356-2361(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The model describes coupled electron/photon transport through extended media in the presence of macroscopic magnetic fields of arbitrary spatial dependence. Collisional transport is accomplished via condensed-history electron Monte Carlo and single-scattering photon Monte Carlo. Production and transport of relevant secondary electrons and photons are included along with electron energy loss straggling. State-of-the-art differential equation solvers are employed in order to obtain the magnetic field trajectories of the electrons. Options are available which allow for transport through variable density media and for switching the field off in regions where transport is collision dominated. Results from selected model applications are also presented. (auth)

21826 DIFFUSION APPROXIMATION TO SURFACE CURRENTS IN A LONG METAL CYLINDER DUE TO EXCITATION BY A LONGITUDINAL ELECTRIC FIELD. Harberger, J. H.; Longmire, C. L. (Mission Research Corp., Santa Barbara, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2381-2385(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

A Green's function is developed to describe the surface current induced by a longitudinal time varying electric field on the surface of an infinite length, perfectly conducting cylinder imbedded in a homogeneous conducting medium. Accurate analytic approximations to this Green's function are also presented along with calculational results of the current response for specified electric field and conductivity behavior. (auth)

21827 EXPERIMENTAL SGEMP RESULTS USING ELECTRON BEAM INJECTION. Fisher, R. J.; Duval, J. S.; Rich, W. F. (Kaman Sciences Corp., Colorado Springs, CO). IEEE Trans. Nucl. Sci.; NS-22: No. 6, (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Results from a SGEMP/IEMP phenomenological experiment designed to explore the behavior of an axially injected electron beam within a cylindrical test chamber are presented. Data on two different injected beams characterized by mean electron energies of 40 and 60 keV and pulse durations of approximately 80 and 30 nsecs full width at half maximum (FWHM) respectively are presented. These data include internal local magnetic fields, transmitted current and transmitted current distributions, localized wall segment currents and radial current densities as a function of pressure. The pressure range extends from approximately 1 mu to over 10 torr. (auth)

21828 APPLICATION OF METHOD OF CHARACTERISTICS TO IEMP CABLE RESPONSE. Chu, R. S.; Terrell, J. H. (GTE Sylvania Inc., Needham Heights, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2408-2412(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Systems studies of IEMP effects on extended conductors oftentimes are facilitated when the excitation region can be represented by a Norton (Thevenin) equivalent circuit. One example of an extended conductor, namely, a coaxial cable, which is subjected to a spatial and time varying gamma (gamma) ray environment following a nuclear burst is considered. Since, in general, the gamma-induced cable dielectric conductivity and air conductivity in air gaps throughout the cable vary in space and time according to the gamma-intensity along the cable, the transmission line equations are with space and time dependent parameters and distributed excitation. The Method of Characteristics (MOC) which is employed to solve this problem for a typical coaxial cable is described in detail; the results are used to predict when a Norton equivalent circuit can be employed in systems problems. (auth)

21829 ELECTRIC CURRENT INDUCED ON INSULATED METALLIC CYLINDER BY COMPTON CURRENT PULSES IN IONIZED AIR. Boyd, R. G. (TRW Systems Group, Redondo Beach, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2431-2433 (Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Merewether and Ezell recently reported a study of the electrical response of bare metallic cylinders to Compton current pulses in ionized air. They solved Maxwell's equations by the method of finite differences. This study was extended to insulated metallic cylinders, by representing the effect of a thin insulating layer by

a boundary condition on the tangential electric field at the ionized air/insulator interface. This method is several orders of magnitude cheaper than the brute force method of using distance increments the thickness of the insulating layer. It is now economically feasible to study the response to a nuclear environment of the many military systems which are insulated by paint, polyethylene, concrete ablative layers or heat shields. (auth)

21830 ELECTRON INTERACTION CROSS SECTIONS IN Al AND Al_2O_3; CALCULATIONS OF MEAN FREE PATHS, STOPPING POWERS, AND ELECTRON SLOWING-DOWN SPECTRA. Ashley, J. C.; Tung, C. J.; Ritchie, R. H. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2533-2536(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The prospects for obtaining better theoretical calculations of experimentally interesting electron interaction effects, over a wide range of electron energies, are now considerably improved through the development of models for valence electron excitation in simple insulators and through the availability of theoretical atomic generalized oscillator strengths for inner shell electron excitation in several low-Z atomic systems. The way in which this information may be used to calculate mean free paths, stopping powers, and electron slowing-down spectra in Al metal and the insulator Al_2O_3 is briefly described. (auth)

21831 SIMULTANEOUS INTEGRAL MEASUREMENT OF ELECTRON ENERGY AND CHARGE ALBEDOS. Lockwood, G. J.; Miller, G. H.; Halbleib, J. A. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2537-2542(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Electron energy and charge albedos were obtained for Be, Al, Ti, Mo, Ta, and U targets over the range of incident energies from 0.1 to 1.0 MeV. In the case of Al, Ta, and U the measurements were extended down to approximately 25 keV. Measurements were made for incident angles from 0^0 (normal) to 60^0, and in some cases 75^0, in 15^0 increments. The results agree well with existing experimental data and with Monte Carlo predictions, except at low energies where the discrepancies are only partially understood. (auth)

21832 CHARGE DEPOSITION, PHOTOCONDUCTION, AND REPLACEMENT CURRENT IN IRRADIATED MULTILAYER STRUCTURES. Frederickson, A. R. (Air Force Cambridge Research Labs., Hanscom AFB, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2556-2561(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

The electronic effects on an irradiated one dimensional dielectric-metal slab structure have been modeled. The effects considered include: radiation driven currents, charge deposition, applied electric fields, deposited charge fields, field driven conductivity currents and radiation induced photoconductivity. The time and spatial dependence of the electric current density, charge density and electric field are determined. The time dependence of the replacement current flowing between metal slabs is calculated. Results are given for x-rays of energies from 30 to 1250 keV. Interesting results predict electric fields greater than 10^6 V/cm, time varying replacement currents which even reverse sign, and multipole electric fields in one dimension. Experimental measurements produce time dependent replacement currents under ^{60}Co irradiation. (auth)

21833 MONTE CARLO ANALYSIS OF DOSE PROFILES NEAR PHOTON IRRADIATED MATERIAL INTERFACES. Garth, J. C. (Air Force Cambridge Research Labs., Bedford, MA); Chadsey, W. L.; Sheppard, R. L. Jr. IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2562-2567(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Dose profiles in silicon and polyethylene next to gold-silicon and gold-polyethylene interfaces, due to x-rays of energies between 10 and 2000 keV, have been calculated using the POEM Monte Carlo electron transport code. By calculating separately the transport of Compton, K-, M- and L-photoelectric, and Auger electrons generated in the gold, each contribution to the total energy fluence profile was obtained and fit to the functional form $A \exp(Bx + Cx^2 + Dx^3)$. Differentiating this form and summing over all source contributions led to excellent analytic representations of the dose profile next to gold for energies below 200 keV. Above 200 keV the dose profiles for two directions of photon irradiation were obtained by the method of Chadsey. Curves of relative dose and relative mean dose as a function of x-ray energy for several distances from the interface were calculated for the first time. (auth)

21834 DIRECT AND ADJOINT MONTE CARLO SAMPLING WITH REFERENCE TO A RESONANCE INTEGRAL PROBLEM IN A SMALL PHASE ELEMENT. Kocic, A. (Institut za Nuklearne Nauke Boris Kidric, Belgrade). Ann. Nucl. Energy; 2: No. 7/8, 555-564(Aug 1975).

Different Monte Carlo methods for estimation of effective resonance integral in a small phase element have been studied and compared with each other. (auth)

Radiation Protection Standards

Refer also to abstracts 20382 and 20564.

21835 STATUS OF IONOGRAPHY. Johns, H. E.; Fenster, A.; Plewes, D. (Univ. of Toronto). Trans. Am. Nucl. Soc.; 22: 111-112(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21836 HEAVY PARTICLE RADIOGRAPHY. Budinger, T. F.; Crowe, K. M.; Cahoon, J. L.; Elischer, V. P.; Huesman, R. H.; Kanstein, L. L. (Univ. of California, Berkeley). Trans. Am. Nucl. Soc.; 22: 112(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21837 OVERALL PERFORMANCE PHANTOM FOR EVALUATING NUCLEAR MEDICINE IMAGING DEVICES. Rollo, F. D. (VA and Univ. of California Hospitals, San Francisco). Trans. Am. Nucl. Soc.; 22: 115-116(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21838 PEDIATRIC PHANTOMS FOR USE IN DOSIMETRIC CALCULATIONS. Shoup, R. L.; Hwang, J. L.; Poston, J. W.; Warner, G. G. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 119(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21839 HEALTH PHYSICS SOCIETY AND THE NATIONAL STANDARDS DEVELOPMENT PROGRAM. Vallario, E. J. (Energy Research and Development Administration, Washington, DC). Trans. Am. Nucl. Soc.; 22: 823(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21840 ASTM STANDARDS FOR NEUTRON DOSIMETRY AND RADIATION ANALYSIS. Lewis, R. H. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 823-825(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Radiation Source Calibration and Standardization

Refer also to abstracts 21567 and 21821.

21841 ^{252}Cf FAST-NEUTRON SPECTRUM MEASURED TO 15 MeV. Johnson, R. H.; Wehring, B. W.; Dorning, J. J.; Ingersoll, D. T. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 727-728(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21842 INITIAL RADIATION DOSE DISTRIBUTIONS ACROSS TYPICAL VILLAGES. I. Methodology. Cohen, M. O.; Beer, M. (MAGI, Elmsford, NY). Trans. Am. Nucl. Soc.; 22: 810-811 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Shielding Calculations and Experiments

Refer also to abstracts 21567, 21569, and 21815.

21843 (BARC-789) RANDOM SAMPLING PROCEDURE FOR ANISOTROPIC DISTRIBUTIONS. Nagarajan, P. S.; Sethulakshmi, P.; Raghavendran, C. P.; Bhatia, D. P. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 45p. Dep. NTIS (US Sales Only) $4.00.

A procedure is described for sampling the scattering angle of neutrons as per specified angular distribution data. The cosine of the scattering angle is written as a double Legendre expansion in the incident neutron energy and a random number. The coefficients of the expansion are given for C, N, O, Si, Ca, Fe, and Pb as these elements are of interest in dosimetry and shielding. 19 figures, 14 tables. (auth)

21844 TREATMENT OF HETEROGENEOUS MATERIALS IN MONTE CARLO CALCULATIONS. Steinburg, H. A. (Mathematical Applications Group, Inc., Elmsford, NY). Trans. Am. Nucl. Soc.; 22: 282-283(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21845 RAY TRACING AND SURFACE INTERSECTION TECHNIQUES FOR DETERMINING COMBINATORIAL GEOMETRY INPUT ERRORS. Beer, M.; Troubetzkoy, E. S.; Cohen, M. O. (Mathematical Applications Group, Inc., Elmsford, NY). Trans. Am. Nucl. Soc.; 22: 283(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21846 SENSITIVITY ANALYSIS IN SHIELDING: AN OVERVIEW. Gerstl, S. A. W. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 791-792(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21847 FORSS SENSITIVITY ANALYSIS CODE SYSTEM. Weisbin, C. R.; Oblow, E. M.; Mynatt, F. R.; Flanagan, G. F. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 792-794(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21848 INTERRELATIONS OF HIGHER ORDER TRANSPORT APPROXIMATIONS: IMPLICATION ON SENSITIVITY METHODS. Albert, T. E. (Science Applications, Inc., Palo Alto, CA). Trans. Am. Nucl. Soc.; 22: 795(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21849 PRELIMINARY CROSS-SECTION SENSITIVITY ANALYSIS FOR AN AIR-OVER-GROUND ENVIRONMENT. Pace, J. V. III; Bartine, D. E. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 796-797(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21850 NEUTRON ATTENUATION PROPERTIES OF SEVERAL SHIELDING MATERIALS. Spaniol, G. C. (Babcock and Wilcox Co., Lynchburg, VA); Maclin, D. M. Trans. Am. Nucl. Soc.; 22: 812-814(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21851 IMPROVED SPACE SHIELDING METHODS. Davis, H. S.; Jordan, T. M. (Jet Propulsion Lab., Pasadena, CA). Trans. Am. Nucl. Soc.; 22: 814-816(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

PHYSICS (THEORETICAL)

General

Refer also to abstracts 21134, 21136–21138, 21238–21240, 21242, 21243, 21246–21249, 21251–21254, 21256–21260, 21262, and 21941.

21852 (CONF-7309135-, pp 366-413) NUMERICAL METHODS FOR SOLVING THE SCHROEDINGER EQUATION. Ixaru, L. G. (Inst. of Atomic Physics, Bucharest). 1973.

From international summer school on boundary problems between nuclear and solid state physics; Predeal, Romania (6 Sep 1973).

In frontier problems on nuclear and solid state physics.

The main problems and difficulties of numerical integration of the Schroedinger equation are discussed. The simplest Schroedinger equation, the one-dimensional one, is taken, and intricate arguments are avoided by replacing them with intuitive arguments. (JFP)

21853 (CONF-7309135-, pp 431-458) PHENOMENOLOGICAL APPROACH TO PHASE TRANSITIONS. Dorobantu, I. A. (Inst. of Atomic Physics, Bucharest). 1973.

From international summer school on boundary problems between nuclear and solid state physics; Predeal, Romania (6 Sep 1973).

In frontier problems on nuclear and solid state physics.

The discussion of phase transformations starts with thermodynamics quantities described as functions of temperature, pressure, etc., and functionals of a special quantity called the order parameter. The Landau form of this approach is able to provide a very intuitive picture of the phenomenon and, most of all, it allows for a somewhat unitary treatment of second order phase transitions in systems as different from gases or magnets and lasers and nuclei. The Landau theory is described and its shortcomings are discussed. The last sections are devoted to examples of Landau models in various physical systems — magnetic systems, superfluids, lasers and nuclei. (auth)

21854 (ITP-75-45) SOME PROBLEMS OF THE GENERALIZED HYPERSPHERIC FUNCTION THEORY. Smirnov, Yu. F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 60p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

In the generalized hyperspheric function method developed by G. F. Filippov with the collaborators, the wave function of the nucleus A expands in D-functions for the group O(A-1) whose structure is studied insufficiently. The present paper dwells in systematic manner upon the theory of irreducible representations of the groups SO(3), SO(4), SO(5). The results obtained allow one to construct the D-functions and to calculate the elements of the generators of the groups O(4), O(5), necessary for performing the calculations for the nuclei consisting of 5 and 6 nucleons. The presentation uses widely the projectional operators for the simple compact Lie groups. (auth)

21855 (LYCEN-7502, pp C.4.1-C.4.6) THEORY OF REGGE POLES AND SCATTERING OF α PARTICLES. Ceuleneer, R. (Univ. de l'Etat, France). 1975. (In French)

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).

Equations for the electromagnetic field of a perfectly conducting sphere with a rectangular antenna are derived using the Watson-Sommerfeld transformation. These equations are used to approximate a Regge pole and applied to the analysis of the elastic scattering of α particles from ^{40}Ca at 24 MeV. (BJG)

21856 (LYCEN-7502, pp S.6.1-S.6.6) TWO-CENTER BASE ADAPTED TO HARTREE-FOCK CALCULATIONS. Berger, J. F.; Gogny, D. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). 1975. (In French)

From 3rd biennial session of nuclear physics; La Toussuire, France (10 Feb 1975).

In third biennial session of nuclear physics studies. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire).

A two-center base was constructed whose functions are expressed as linear combinations of functions of the harmonic oscillator taken around two distinct centers with distinct parameters. (JSR).

21857 (PP-450) OPERATOR FOR THE OBSERVABLE TIME. Recami, E. (Catania Univ. (Italy). Istituto di Fisica Teorica). Dec 1975. 11p. Dep. NTIS (US Sales Only) $3.50.

Within a space-time description of nonrelativistic quantum objects in terms of wave packets, a Hermitian operator is introduced in quantum mechanics for the observable time, in a very natural and simple way. (auth)

21858 THERMAL AND MAGNETIC BEHAVIOR OF ONE-DIMENSIONAL MAGNETS. Gerstein, B. C. (Ames Lab., IA). pp 125-146 of Low-Dimensional Cooperative Phenomena. Keller, H. J. (ed.). New York; Plenum Publishing Corp. ([nd]).

Static thermal and magnetic behavior of one dimensionally interacting magnetic solids are dealt with. Magnetic heat capacities and susceptibilities of such systems are treated. In keeping with the spirit of the ASI as a "school," the material is quite elementary, with the idea of introducing the reader to the concept of how non-interacting three dimensional systems behave, how this behavior differs from that expected for lower dimensional systems, and to the techniques used to calculate thermodynamic properties of lower dimensional systems. Emphasis is on the manner in which thermodynamic behavior changes as 1-D and higher dimensional interactions become important. Classic calculations to illustrate this point are considered in detail. The following topics are included: (I) the physical basis of the "exchange" interaction, (II) superexchange, (III) initial susceptibility and magnetic heat capacities of systems with zero exchange (Curie Law behavior and Schottky heat capacities), and (IV) the transfer matrix technique for Ising Model calculations, with, and without a molecular field. 2 tables, 3 figures (auth)

21859 TIME DEPENDENT VARIATIONAL APPROACH TO SEMICLASSICAL DYNAMICS. Heller, E.J. (The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 64: No. 1, 63-73 (1 Jan 1976).

Explicitly time dependent methods for semiclassical dynamics are explored using variational principles. The Dirac-Frenkel-McLachlan variational principle for the time dependent Schrödinger equation and a variational correction procedure for wavefunctions and transition amplitudes are reviewed. These variational methods are shown to be promising tools for the solution of semiclassical problems where the correspondence principle, classical intuition, or experience suggest reasonable trial forms for the time dependent wavefunction. Specific trial functions are discussed for several applications, including the curve crossing problem. The useful semiclassical content of the time dependent Hartree approximation is discussed. Procedures for the variational propagation of density matrices are also derived. (auth)

21860 REMARK ON THE THOMAS-FERMI EQUATION. Biedenharn, L. C. (Duke Univ., Durham, NC). Int. J. Quant. Chem., Symp.; No. 9, 31-33(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

It is suggested that the structural concepts involved in obtaining this equation are quite fundamental and equally as important as the equation itself. An illustrative example is given. (GHT)

21861 HERMITIAN SYMMETRY AND LOW-ORDER STATISTICAL DENSITY MATRICES. Handler, G. S. (Univ. of Georgia, Athens). Int. J. Quant. Chem., Symp.; No. 9, 35-42(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The Dirac and Bloch single-particle density matrices in Thomas-Fermi approximation are derived ab initio by incorporating the idea of a "local" approximation into an otherwise exact representation. The forms found yield the usual densities in Thomas-Fermi approximation and are Hermitian. (auth)

21862 INTRODUCTION TO MODERN THEORETICAL PHYSICS, Volume II, Quantum Theory and Statistical Physics. Harris, E. G. New York; John Wiley and Sons, Inc. (1975). 417p.

The topics discussed include the history and principles, some solvable problems, and symmetry in quantum mechanics, interference phenomena, approximation methods, some applications of nonrelativistic quantum mechanics, relativistic wave equations, quantum theory of radiation, second quantization, elementary particles and their interactions, thermodynamics, equilibrium statistical mechanics and its applications, the kinetic theory of gases, and collective phenomena. (JFP)

21863 SELF-CONSISTENT RELATIVISTIC APW METHOD WITH THE SPIN-ORBIT INTERACTION TREATED AS A PERTURBATION. Boyer, L. L.; Klein, B. M. (Naval Research Lab., Washington, DC). Int. J. Quant. Chem., Symp.; No. 9, 511-518(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A simple method for including spin-orbit corrections in self-consistent relativistic APW band structure calculations is presented in which the spin-dependent part of the APW matrix is treated as a perturbation. The solution of the spin-independent problem is used in a way that requires little additional time or coding to include spin. The full calculational procedure is discussed and calculations of spin-orbit splitting in TaC are described to illustrate the method. (auth)

21864 LOCAL EXCITATIONS IN CRYSTALLINE SYSTEMS. Collins, T. C.; Kunz, A. B.; Ivey, J. L. (Aerospace Research Labs., Wright Patterson Air Force Base, OH). Int. J. Quant. Chem., Symp.; No. 9, 519-527(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Three systems are considered which have large local field effects in their excited spectra. The first system is the absorption of soft x-ray radiation by the insulating crystal LiF, for which the lowest excitonic transition from the core state to the conduction band is forbidden. Next the optical properties of LiF in the 1-2-Ry energy range are examined. The last system discussed is NiO where the excitation spectra in the 0-20-eV energy range are investigated. In all three systems it is pointed out that a proper description must go beyond simple Hartree-Fock band theory and should include short-range correlation effects as well as the usual long-range correlations. (auth)

21865 POLARIZATION CALCULATIONS FOR FERROELECTRIC SODIUM NITRITE. Henkel, J. H.; Collins, T. C.; Ivey, J. L.; Euwema, R. N. (Aerospace Research Labs., Wright Patterson Air Force Base, Ohio). Int. J. Quant. Chem., Symp.; No. 9, 529-533(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Energy bands were calculated for ferroelectric sodium nitrite using a plane-wave Gaussian basis set and an X alpha exchange. Wave functions were calculated at five symmetry k points, and the electron charge density was averaged over the five symmetry points. The electric dipole moment per unit molecule was calculated by assuming that the boundaries of a neutral molecule were given by minimum charge density contours. The spontaneous polarization for ferroelectric sodium nitrite calculated using the above assumption was 9.9×10^{-6} C/cm^2, which agrees with the experimental value of 9.5×10^{-6} C/cm^2 measured by Tokugawa. (auth)

21866 ELECTRONICALLY DRIVEN INSTABILITIES IN METALS. Freeman, A. J. (Argonne National Lab., IL); Myron, H. W.; Rath, J.; Gupta, R. P. Int. J. Quant. Chem., Symp.; No. 9, 535-550(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Electronically driven instabilities of the conduction electrons in metals are manifested as spin density waves, charge density waves accompanied by periodic lattice distortions, or in structural phase transformations and are thought to result from a divergence in chi(q), the generalized static electronic susceptibility. Examples of these instabilities are discussed by means of accurate calculations of the noninteraction conduction electron susceptibility chi(q) using results of energy-band calculations and our recently developed analytic tetrahedron linear energy method, notably, the occurrence of change density waves in the layered dichalcogenides and the body-centered cubic to omega phase transformation in metals like Zr. (auth)

21867 HIGHER TIME DERIVATIVES OF THE GENERALIZED LIAPUNOV FUNCTION. Schieve, W. C.; Bulsara, A. R. (Univ. of Texas, Austin). Int. J. Quant. Chem., Symp.; No. 9, 471-475 (1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Using the generalized N-body expression for a Liapunov functional developed by Prigogine and coworkers, a condition is obtained whereby the successive time derivatives of this function alternate in sign for weakly coupled systems. This generalized Liapunov function contains contributions from the diagonal as well as off-diagonal (correlation) components of the density matrix. The alternating sign condition is applied (and seen to hold true) for the cases of elastic phonon scattering in a lattice, three-phonon scattering (the anharmonic lattice), and the quantum electron gas. It is also proved simply for the Friedrichs model. (auth)

21868 VIRIAL THEOREM WITH BOUNDARY CONDITIONS APPLICATIONS TO THE HARMONIC OSCILLATOR AND TO SINE-SHAPED POTENTIALS. Weislinger, E.; Oliver, G. (Univ., Nancy). Int. J. Quant. Chem., Symp.; No. 9, 425-433(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

New objective formulations of the quantum virial theorem rise from a parallelism drawn with d'Alembert's principle. In particular, boundary conditions correspond to constraints whose virial give a complementary term to the usual formulation of the quantum virial theorem. Two examples are examined, first the non-Coulombic and nonperiodical harmonic oscillator for which all the virials can be calculated and compared; second the periodical sine-shaped potential connected with Mathieu's functions, for which only the complementary term due to the cyclic conditions is investigated, showing that its importance is varying from zero to twice the mean kinetic energy when the amplitude of the interaction is vanishing, in the limiting free-electron case. A remark is also made about normalization and the use of mean energy values over a part of space, when mathematical integration is stoped on a surface (partitioning of a molecule, for example) or on a cell in periodical solid-state problems. (auth)

21869 LAPLACE-TYPE, BIPOLAR, AND POLYPOLAR EXPANSIONS OF r/sup N/Y/sub L//sup M/(theta,phi) AND HELMHOLTZ HARMONICS j/sub L/(kr)Y/sub L//sup M/(theta,phi) FOR MOLECULAR CALCULATIONS. Steinborn, E. O.; Filter, E. (Univ., Regensberg, Ger.). Int. J. Quant. Chem., Symp.; No. 9, 435-442(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL (19 Jan 1975).

Relationships of the general form: f/sub alpha/$(r_1 + r_2 + \ldots +$ r/sub n/) equals SIGMA/sub lambda/SIGMA/sub mu/ . . . SIGMA /sub eta/ C/sub lambda mu . . . eta//sup alpha/f/sub lambda/ (r_1)f/sub mu/(r_2) . . . f/sub eta/(r/sub n/), are given for functions X/sub N,L//sup M/(r) equals r/sup N/Y/sub L//sup M/(theta,phi) and Helmholtz solid harmonics b/sub L/(kr) Y/sub L//sup M/(theta,phi), where Y/sub L//sup M/(theta,phi) is a spherical surface harmonic and b/sub L/(kr) stands for a spherical Bessel, Hankel, or Neumann function. The monopolar or Laplace-type (n equals 2), bipolar (n equals 3), and polypolar expansions (arbitrary n) of these functions allow many applications in theoretical chemistry and physics. Expansions of functions X/sub N,L//sup M/(r), which occur in orbitals and operators, are particularly useful for molecular calculations, especially for the evaluation of multicentered integrals. Expansions of Helmholtz solid harmonics are advantageous for instance in scattering theory. (auth)

21870 DISSIPATIVE STRUCTURES, DYNAMICS, AND ENTROPY. Prigogine, I. (Univ. Libre, Brussels). Int. J. Quant. Chem., Symp.; No. 9, 443-456(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A short survey of the phenomenological formulation of the second law and of dissipative structures is presented. The microscopic meaning of entropy and entropy production is then discussed in terms of our formulation of "dynamics of correlations." It is shown that our formalism applies both to finite quantum mechanical systems and to large systems. The equations of motion of large systems are written in a form which displays explicitly the distinction between reversible processes (which leave the entropy constant) and irreversible processes (which increase the entropy). In this way a unified formulation of dynamics and thermodynamics is achieved. 34 refs (auth)

21871 REMARK ON TIME EVOLUTION AND SPECTRAL CONCENTRATION. Braendas, E.; Froelich, P. (Univ. of Florida, Gainesville). Int. J. Quant. Chem., Symp.; No. 9, 457-459(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Irreversibility is studied from the point of view of a time-dependent partitioning technique, based on retarded and advanced evolution operators. Application to the Stark effect in the hydrogen atom showed that correct numerical results for the real part of the resonance, that is, the complex pole of the Green's function, could be obtained. (GHT)

21872 SEPARABILITY OF ELECTRONIC WAVE FUNCTIONS. Adams, W. H. (Rutgers-the State Univ., New Brunswick, NJ). Int. J. Quant. Chem., Symp.; No. 9, 367-373(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The idea that an electronic wave function might be adequately approximated by an antisymmetrized product of a core with a

valence wave function is discussed as a special case of the separability hypothesis. A natural function analysis of localized wave functions is proposed as a criterion for separability. A generalization of Brillouin's theorem is shown to be a consequence of the effective core and valence Hamiltonians which are proposed. (auth)

21873 RAYLEIGH PRINCIPLE FOR A SUBSPACE OF A QUANTUM SYSTEM. Srebrenik, S. (McMaster Univ., Hamilton, Ont.). Int. J. Quant. Chem., Symp.; No. 9, 375-383(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

We show that for one-electron systems the "virial fragments," fragments that are bounded by surfaces of zero flux in the gradient of the charge density, possess the natural boundaries required for the application of the theorems of the calculus of variation and the theorem of Hohenberg and Kohn. (auth)

21874 DIRECT OPTIMIZATION OF NONLINEAR PARAMETERS. Weltin, E. E. (Univ. of Vermont, Burlington). Int. J. Quant. Chem., Symp.; No. 9, 337-341(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Nonlinear parameters in orbitals are optimized by a search for a minimum on the total energy versus parameter surface. In a nonorthogonal CI these parameters are independent. The partial derivatives of the energy are then evaluated analytically and used in a simultaneous variation of all parameters in the direction of steepest descent. Some results for atomic wave functions with real s and p STOS are presented. (auth)

21875 APPROXIMATE VARIATIONAL PERTURBATION MODEL FOR MOLECULAR ENERGY. Cullen, J.; Zerner, M. C. (Univ. of Guelph, Ont.). Int. J. Quant. Chem., Symp.; No. 9, 343-350(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A variational procedure is applied to the perturbation treatment of the configuration interaction matrix of Diner, Malrieu, and Claverie (PCILO) to yield a method that appears to better reproduce the exact energy surface for small molecules. In addition, many points on the potential energy surface can be searched with N^2 steps, where N is the number of basis orbitals, until the region of interest is uncovered. The procedure then becomes competitive in execution time with semiclassical methods used in examining large molecules. The implications of applying this variational procedure for large molecules are discussed. (auth)

21876 ORBITAL CORRELATION EFFECTS. II. Potential Curve and Ionization Potential of Boron Hydride. Mehler, E. L. (Univ., Basel); Van der Vele, G. A.; Nieuwpoort, W. C. Int. J. Quant. Chem., Symp.; No. 8, 245-254(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

With the help of the independent pair-potential approximation (IPPA) the valence-shell correlation effects in BH have been calculated at nine internuclear separations. The results are compared with several other methods, including the coupled electron pair approximation (CEPA) and a full configuration interaction expansion. The stability of the IPPA against a unitary transformation of the occupied orbitals has also been investigated, and it is shown that the IPPA is nearly invariant against such transformations. The Dunham procedure has been applied to the results, and the spectroscopic constants obtained from the various approximations are compared. It is furthermore demonstrated that many of the defects present in the Hartree–Fock part of the potential curve and arising from the use of medium-quality basis sets can be eliminated by combining the correlation results with Hartree–Fock results from good-quality basis sets and reapplying the Dunham procedure. Finally the IPPA has been applied to BH^+, and the first vertical ionization potential of BH was determined. (auth)

21877 TRANSITION OPERATORS FOR DESCRIBING IONIZATION AND EXCITATION. Goscinski, O. (Univ. of Uppsala). Int. J. Quant. Chem., Symp.; No. 9, 221-227(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A transition operator, involving one calculation per excitation process, is reviewed. Applications to photoelectron and Auger Spectroscopy are discussed. Relaxation is included. (auth)

21878 EXTENSION OF KOOPMANS' THEOREM. III. Ionization Energies of the Open-Shell Atoms Li and B. Morrison, R. C. (East Carolina Univ., Greenville, NC); Day, O. W.; Smith, D. W. Int. J. Quant. Chem., Symp.; No. 9, 229-235(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Extended Koopmans' theorem orbital energies are calculated using unsymmetrized hole states for the Li ^2S and B ^2P states. These orbital energies are compared with ionization energies obtained from DELTA CI calculations in the same basis sets as well as with experimental ionization energies. The extended Koopmans' orbital energies over unsymmetrized hole states for the outer shell orbital 2s alpha of Li and for the two outer shell orbitals 2p alpha and 2s beta of B agree well with DELTA CI ionization energies and with experimental ionization energies. The overlap of the 2s alpha hole state of Li with a CI wave function of Li^+ is 0.999983. The corresponding overlaps of the 2p alpha and 2s beta hole states of B with CI wave functions are 0.996588 and 0.999258, respectively. The unsymmetrized hole states for inner shell orbitals are strong mixtures of different symmetry types and yield increasingly poorer ionization energies. (auth)

21879 PARTICLE-HOLE OPERATORS AS STATE GENERATORS DEFECTS IN THE RANDOM PHASE APPROXIMATION (AS EVIDENCED BY CALCULATIONS ON THE FROZEN-K-SHELL MODEL OF THE B^+ ION). Larson, E. G. (Brigham Young Univ., Provo, UT). Int. J. Quant. Chem., Symp.; No. 9, 199-212(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The state-generating properties of particle-hole operators are analyzed for the 2-fermion case and applied to the analysis of approximation procedures of the random phase approximation (RPA) type. Calculations were performed on the frozen-K-shell model of the B^+ ion (a quasi 2-electron system). These calculations are used to analyze the validity of the assumptions and approximations made by the RPA. It is found that the "$(1s^2 2s2p)$" ^1P/sub odd/ and ^3P/sub odd/ states and the $(1s^2 2s3s)$ ^3S state could be moderately well described by the standard PRA. The $(1s^2 2s3d)$ ^1D and ^3D states require the use of a correlated ground state and "killer-condition"-satisfying particle-hole operators not of the standard RPA type, if they are to be adequately described by a method of the RPA family. The $(1s^2 2s3d)$ ^1S state requires, in addition, the use of non-"killer-condition"-satisfying particle-hole operators ("number" operators) in order to be adequately described by a particle-hole method. Such number operators are not supported by methods of the RPA family, as they cannot be sustained by the particle-hole inner projection of the Fourier-transformed polarization propagator (causal Green's function). The analysis of the particle-hole operators also leads to the definition of particle-hole wave functions that represent their associated states in forming scalar products. The form of these wave functions is also presented here. (auth)

21880 ENERGY AS A FUNCTIONAL OF THE DENSITY MATRIX. Berrondo, M. (Univ. of Mexico, Mexico City); Goscinski, O. Int. J. Quant. Chem., Symp.; No. 9, 67-73(1975).

From proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A variational principle is presented for the ground state energy in terms of the one-particle density matrix. The functional expression of the energy in terms of the density matrix is obtained as the limit of zero temperature of the free energy. This is achieved by adding a nonlocal external potential to the N-body Hamiltonian and obtaining a renormalized equation for the density matrix instead of the Green's function. By eliminating the external source it was possible to express the energy as a functional of the density matrix. (auth)

21881 NONLINEAR EVOLUTION EQUATIONS SOLVABLE BY THE INVERSE SPECTRAL TRANSFORM ASSOCIATED WITH THE MULTICHANNEL SCHROEDINGER PROBLEM, AND PROPERTIES OF THEIR SOLUTIONS. Calogero, F. (Univ., Rome); Degasperis, A. Lett. Nuovo Cim.; 15: No. 3, 65-69(17 Jan 1976).

The main results obtained by applying to the multichannel Schroedinger problem a recent technique based on generalized Wronskian relations and suitable to generate nonlinear evolution equations solvable by the inverse spectral transform method and to investigate their solutions. These results include a large class of systems of nonlinear evolution equations solvable via the IST method associated with the multichannel Schroedinger problem, and a large class of Baecklund transformations relating different solutions of these equations. In the special case with only one space variable and with coefficients depending only on time, a remarkable functional equation that relates the solution at one time to the same solution at another time, is also given. (JFP)

21882 SPECTRAL PROPERTIES OF DIRAC OPERATOR WITH OPTICAL POTENTIAL. Suturin, M. G. Vestn. Leningr. Univ., Fiz., Khim.; No. 22, 24-27(Nov 1974). (In Russian)

The structure of the spectrum of a three-dimensional Dirac operator defined as follows was studied: The potential is assumed to be a smooth scalar, complex-valued function, with spherical symmetry and vanishing at infinity. M-functions were constructed for the radial operators H_l, $l = \pm 1, \pm 2, \ldots$, induced by the Dirac operator. Their short-wave asymptotic behavior uniform in l was obtained. From this asymptotic behavior it follows that, in particular, when $|l| \gg 1$, the spectrum of H_l operators is continuous and therefore only a finite number of H_l operators contributes to the discrete spectrum of the initial three-dimensional Dirac operator. References 4. (JPRS)

21883 IRREVERSIBILITY AND QUANTUM MEASUREMENT: THE OBSERVER'S ROLE. Bhandari, R. (Raman Research Inst., Bangalore, India). Pramana; 3: No. 1, 1-9(1974).

The role of the observer in physical theories in the sense of the observer's viewpoint determining prominent features of the observed phenomena is discussed with reference to the problem of irreversibility and quantum measurement, the latter being closely related to the problem of classical behavior of quantum systems. A completely subjective interpretation of irreversibility is proposed. It is claimed that irreversibility belongs only to phenomena as observed by a restricted observer who must project all phenomena on a restricted subset of the set of all possible states. The possibility of a completely unrestricted observer who does not see irreversibility is discussed. (Ind. Sci. Abstr.)

Quantum Field Theories

Refer also to abstracts 21051, 21270, 21371, 21372, 21421, 21430, 21431, 21532, 21534, 21929, 21941, and 21943.

21884 (ANL/HEP/PR-76-04) COLLECTIVE ENHANCEMENT OF INCLUSIVE CROSS SECTIONS AT LARGE TRANSVERSE MOMENTUM IN STOCHASTIC-FIELD MULTIPARTICLE THEORY. Arnold, R. C. (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. Dep. NTIS $3.50.

A stochastic-field calculus, previously discussed in connection with Regge intercepts and instability questions, is applied to inclusive cross sections, and is shown to predict a growth with energy of large-P/sub perpendicular/ to inclusives. (auth)

21885 (JINR-D1-5969, pp 604-631) AXIOMS OF THE QUANTUM THEORY OF LOCALIZED FIELDS AND THEIR CONSEQUENCES. Nguen Van Kh'eu. 1971. (In Russian)

From international symposium on high energy physics; Dresden, Federal Republic of Germany (19 Apr 1971).

In proceedings of the international symposium on high energy physics. (Joint Inst. for Nuclear Research, Dubna (USSR)).

21886 FUNDAMENTAL IDENTITY FOR THE INFINITE-ORDER-ZERO NATURE IN QUANTUM ELECTRODYNAMICS. Manoukian, E.B. (Dublin Institute for Advanced Studies, Dublin 4, Ireland). Phys. Rev. D 12: No. 10, 3365-3367 (15 Nov 1975).

The fundamental identity leading to the infinite-order-zero nature of the eigenvalue condition $[F^{(1)}(x)]$ as well as of the electromagnetic-current $2n$-point function is derived in quantum electrodynamics, quite economically, directly from Schwinger's dynamical (variational, action, etc.) principle, thus avoiding any combinatoric analysis. (auth)

21887 NOTE ON REGGE BEHAVIOR IN A NONPOLYNOMIAL LAGRANGIAN THEORY. Biswas, S.N. (School of Theoretical and Environmental Sciences, Jawahar Lal Nehru University, New Delhi-57, India); Malik, G.P. Phys. Rev. D 12: No. 10, 3360-3362 (15 Nov 1975).

Regge trajectories are calculated for the nonpolynomial field $U(\phi(x)) = 1/[1 + g\phi(x)]$ by using an earlier determined representation for the superpropagator and employing a method due to Stroffolini. The result obtained seems to suggest that Regge-type behavior is model independent. (auth)

21888 EFFECTIVE LAGRANGIAN FOR THE YANG-MILLS FIELD. Duff, M.J. (Mathematics Department, King's College, London, England); Ramón-Medrano, M. Phys. Rev. D 12: No. 10, 3357-3359 (15 Nov 1975).

A recently proposed method for evaluating effective Lagrangians is applied to the Yang-Mills field. (auth)

21889 ASYMPTOTIC SPECTRAL FORM OF THE V-PARTICLE PROPAGATION FUNCTION AND THE GELL-MANN-LOW FUNCTION. Dittrich, W. (Institut für Theoretische Physik der Universität Tübingen, Tübingen, West Germany). Phys. Rev. D 12: No. 10, 3353-3355 (15 Nov 1975).

We present an exact solution of the Gell-Mann–Low–type equation in the Lee model. However, rather than follow the conventional renormalization-group procedure, we apply the simple, physically motivated version given recently by Schwinger. (auth)

21890 NULL-PLANE APPROACH TO NONLINEAR INTERACTIONS BETWEEN ELECTROMAGNETIC QUANTUM FIELDS: FORWARD PHOTON-PHOTON SCATTERING, REGULARIZATION, AND DELBRÜCK SCATTERING. Garavaglia, T. (Coláiste Teichneolaiochta, Sráid Chaoimhin and Institiúid Ard-Leighinn Bhaile Átha Cliath Baile Átha Cliath 4, Éire (Ireland)). Phys. Rev. D 12: No. 10, 3327-3340 (15 Nov 1975).

We develop a method for the evaluation of higher-order contributions in quantum electrodynamics. We illustrate the considerable advantages of this method by studying second-order vacuum polarization, forward photon-photon scattering, and general Delbrück scattering. We also discuss the difficulties associated with frequently suggested regularization methods and the use of crossing relations. In addition we illustrate how the null-plane approach may be used in the study of high-energy Delbrück scattering. Finally, we present a method for the evaluation of traces; this method greatly reduces the labor required to obtain useful results. (auth)

21891 TIME GRAPH OF THE UNSTABLE PARTICLE AND THE NONUNITARY REPRESENTATIONS OF THE POINCARÉ GROUP. Tripathy, K.C. (Department of Physics and Astrophysics, University of Delhi, Delhi-110007, India). Phys. Rev. D 12: No. 10, 3302-3309 (15 Nov 1975).

The second-quantization scheme for neutral scalar fields describing an unstable particle is formally developed within the framework of the nonunitary representations of the Poincaré group, $\bar{P}_+^\uparrow$. The fields satisfy the postulates of conventional field theories with a modified spectral condition. The exponential decay law for the time graph of the unstable particle is derived from a study of the asymptotic behavior of the causal Green's function. (auth)

21892 GOLDSTONE REALIZATION OF γ_5-GAUGE SYMMETRY IN QUANTUM ELECTRODYNAMICS. Narayanaswamy, P. (Center for Particle Theory, University of Texas, Austin, Texas 78712). Phys. Rev. D 12: No. 10, 3296-3301 (15 Nov 1975).

The relevance of the Goldstone theorem to quantum electrodynamics with zero-bare-mass electrons is re-examined. It is shown that solutions exist corresponding to the Goldstone realization of γ_5-gauge symmetry. The result will also be valid for fermion quarks interacting strongly with massless vector gluons. (auth)

21893 THIRRING FERMIONS AT HIGH TEMPERATURE. Deo, B.B.; Kumar, S. (Physics Department, Utkal University, Bhubaneswar, Orissa, India). Phys. Rev. D 12: No. 10, 3291-3295 (15 Nov 1975).

A Green's-function method is used to study the thermodynamic properties of self-interacting massless fermions in one space dimension fermions in one space and one time dimension. It is shown that the exact expressions can be obtained for the thermodynamic one-particle Green's function for the case where the dimensionless chemical potential $\mu=0$, which is identical with the corresponding field-theoretic Green's function. The number density is obtained as an infinite sum. It exhibits a peculiar peaked behavior as a function of momentum. The energy, however, is a continuous function of temperature. (auth)

21894 RELATIVISTIC COLLECTIVE MOTION. Sugawara, H. (National Laboratory for High Energy Physics, Oho-machi, Tsukuba-gun, Ibaraki-ken, 300–32, Japan). Phys. Rev. D 12: No. 10, 3272-3278 (15 Nov 1975).

The generator coordinate method in nuclear physics is applied to relativistic field theories. The Gaussian approximation is utilized to calculate the ground-state energy. (auth)

21895 FERMION-FERMION SCATTERING IN A YANG-MILLS THEORY AT HIGH ENERGY: SIXTH-ORDER PERTURBATION THEORY. McCoy, B.M. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794); Wu, T.T. Phys. Rev. D 12: No. 10, 3257-3271 (15 Nov 1975).

We study the high-energy behavior of the elastic scattering of two isospin-$\frac{1}{2}$ fermions interacting through the Yang-Mills field. The Higgs mechanism is invoked so that there is no infrared divergence. In the sixth order, the amplitude for isovector exchange is found to behave as $s \ln^2 s$ multiplied by a function of t, while the amplitude for isoscalar exchange behaves as $s \ln s$ multiplied by another function of t. These results are qualitatively different from the answers previously given in the literature. In particular, there is no contribution to the leading terms from large transverse momentum transfers; this is the reason why we obtain one less factor of $\ln s$ in sixth order. (auth)

21896 DYNAMICAL SYMMETRY BREAKING ON A LATTICE. Zee, A. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 12: No. 10, 3251-3256 (15 Nov 1975).

We propose to study dynamical symmetry breaking on a spatial lattice. Experiences with solid-state physics suggest that one should deal with an effective interaction between quarks and antiquarks rather than starting with the fundamental local Lagrangian. As an example, we study the $(\bar{\psi}\psi)^2 = (\Sigma_{a=1}^{N}\bar{\psi}\psi)^2$ interaction of massless fermions in two dimensions on a lattice in the approximation of a large number of degrees of freedom, N. We show explicitly that the model reduces to

one-dimensional superconductivity by following the original methods of Bardeen, Cooper, and Schrieffer. The lattice coupling constant g_0^2 is found to go as a for large lattice spacing a and as $-1/\ln a$ for small a, and to have a finite cut for imaginary values of a. The same result may be obtained by a path-integral approach. For $N = 1$ the model reduces to an antiferromagnetic chain. (auth)

21897 SCALAR BOUND STATES AND DYNAMICAL SYMMETRY BREAKING. Lemmon, J.; Mahanthappa, K.T. (Department of Physics, University of Colorado, Boulder, Colorado 80302). Phys. Rev. D 12: No. 10, 3230-3236 (15 Nov 1975).

The possibility of a model with a massive fermion, axial-vector and scalar mesons, and a massless vector meson originating as a dynamical consequence of a chiral U(1) $\times$ U(1) gauge-invariant model with a massless fermion and vector and axial-vector mesons is explored. A recent approach due to Cornwall which makes use of an effective Lagrangian combined with the Callan-Symanzik equations, and its extension, are used with an assumption similar to that of the Baker-Johnson finite quantum electrodynamics. The physical quartic scalar coupling constant and the ratios of physical masses of axial-vector and scalar mesons with respect to that of fermion are expressed in terms of the vector and axial-vector gauge coupling constants. (auth)

21898 FERMION CONTRIBUTIONS TO THE EFFECTIVE POTENTIAL AND THE KINK MASS. Chang, S. (Physics Department, University of Illinois, Urbana-Champaign, Illinois 61801); Yan, T. Phys. Rev. D 12: No. 10, 3225-3229 (15 Nov 1975).

We compute the first nontrivial quantum corrections to both the effective potential and the kink mass due to the fermions in a specific nonlinear field theory in one space and one time dimension. We find that the fermion contributions are of the opposite sign to the boson contributions, and tend to stabilize the abnormal vacuum and the semiclassical kink solutions. (auth)

21899 COMMENTS ON VACUUM POLARIZATIONS OF MAGNETIC MONOPOLES. Yueh, W.R. (Department of Physics, Columbia University, New York, New York 10027). Phys. Rev. D 12: No. 10, 3221-3224 (15 Nov 1975).

We calculate the electric vacuum polarizations induced by the action of a static monopole charge and find out that there is no induced vacuum currents at all to all orders of the external field and to all orders of the radiative corrections. We also argue that the super-strong Coulomb-type potential screens itself into a short-range one so that there is no magnetic charge renormalization. (auth)

21900 BACKGROUND-FIELD METHOD VERSUS NORMAL FIELD THEORY IN EXPLICIT EXAMPLES: ONE-LOOP DIVERGENCES IN THE *S* MATRIX AND GREEN'S FUNCTIONS FOR YANG-MILLS AND GRAVITATIONAL FIELDS. Grisaru, M.T.; van Nieuwenhuizen, P.; Wu, C.C. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 12: No. 10, 3203-3213 (15 Nov 1975).

The gauge dependence in the background-field method of counterterms on and off the mass shell is investigated in several gauges for Yang-Mills and gravitational fields, including the axial gauge. The results agree with theorems of DeWitt and Kallosh. The relation between the quantum and classical gauge-fixing terms is discussed. It is shown how to determine specific *S*-matrix elements in the background-field method. A complete calculation using normal field theory of the one-loop divergences of scalar-scalar scattering through graviton exchange is presented. The results agree with those obtained in the background-field method by 't Hooft and Veltman. (auth)

21901 SOLUTION OF THE FISK-TAIT EQUATION FOR SPIN-$\frac{3}{2}$ PARTICLES IN INTERACTION WITH A HOMOGENEOUS MAGNETIC FIELD. Seetharaman, M.; Prabhakaran, J.; Mathews, P.M. (Department of Theoretical Physics, University of Madras, Madras 600 025, India). Phys. Rev. D 12: No. 10, 3195-3199 (15 Nov 1975).

The Fisk-Tait wave equation for spin-$\frac{3}{2}$ particles, which has been shown to remain causal even with coupling to external fields, is shown to be also free of other types of difficulties by which the Rarita-Schwinger formalism is plagued. Unlike the latter, the Fisk-Tait equation with coupling to a homogeneous magnetic field has no modes with complex frequencies irrespective of the magnetic field strength. We show this by explicit solution of the equation. Further, the invariant scalar product in the Fisk-Tait theory, expressed in terms of the independent components of the wave functions, is shown to be unaffected by the presence of the external field. (auth)

21902 CAUSALITY OF PROPAGATION OF SPIN-$\frac{3}{2}$ FIELDS COUPLED TO SPINOR AND SCALAR FIELDS. Prabhakaran, J.; Seetharaman, M.; Mathews, P.M. (Department of Theoretical Physics, University of Madras, Madras-600 025, India). Phys. Rev. D 12: No. 10, 3191-3194 (15 Nov 1975).

Recent investigations on the causality of propagation of spin-$\frac{3}{2}$ fields have revealed that the Bhabha-Gupta equation shares with the Fisk-Tait equation the advantage of being free from noncausality in the presence of minimal electromagnetic interaction, provided that the arbitrary parameters occurring in the theory are suitably restricted. Since the familiar Rarita-Schwinger theory is known to suffer from noncausality troubles the above-mentioned result is of considerable importance. We extend it in this paper by showing that causality is preserved in the above theories even in the presence of a different type of interaction involving scalar and spinor fields. Thus the result obtained earlier with the electromagnetic interaction is not merely a fortuitous circumstance. (auth)

21903 INFRARED DECOUPLING OF MASSIVE FIELDS AND THE RENORMALIZATION GROUP. Olesen, P. (The Niels Bohr Institute, University of Copenhagen, DK-2100 Copenhagen Ø, Denmark). Phys. Rev. D 12: No. 10, 3181-3190 (15 Nov 1975).

We impose the decoupling of massive fermions in the infrared limit as a boundary condition on the renormalization-group equations in the formulations of Gell-Mann and Low and of Weinberg. We make the assumption that if one has a finite infrared-stable fixed point in one formalism, then this remains true in the other formalism. Some constraints are derived for asymptotically free theories. It is shown that if the pure Yang-Mills theory has a finite infrared-stable fixed point, then this (fermion-independent) coupling must also be the fixed point in a theory with massless fermions. Since the theory with massless fermions still "remembers" that it ceases to be asymptotically free with sufficiently many fermions, we argue that the Yang-Mills fixed point is unlikely to be a fixed point of the massless theory, or that the β function is likely to have a singularity. (auth)

21904 RENORMALIZATION OF NON-ABELIAN GAUGE THEORIES IN A BACKGROUND-FIELD GAUGE. II. GAUGE-INVARIANT OPERATORS. Kluberg-Stern, H.; Zuber, J.B. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, BP No.2-91190 Gif-sur-Yvette, France). Phys. Rev. D 12: No. 10, 3159-3180 (15 Nov 1975).

The Ward-Slavnov identities satisfied by the Greens functions with one insertion of a gauge-invariant operator are studied in the background-field gauge. As a consequence, the counterterms for a given gauge-invariant operator must satisfy a system of equations, whose general solution is found in the simplest cases of operators of low dimension ($d \leqslant 6$) or low twist ($\tau \leqslant 3$) and conjectured in the general case. It then follows that the renormalized Greens functions satisfy the same Ward identities as the bare, regularized ones. We deduce a definite prescription for the practical calculation of the anomalous dimensions of gauge-invariant operators which do not vanish in the classical limit: this prescription is formulated in the background gauge or in the usual Fermi-type gauge. (auth)

21905 GAUGE-INVARIANT FORMULATION OF THE DYNAMICS OF THE QUANTIZED YANG-MILLS FIELD. Treat, R.P. (Department of Physics, West Virginia University, Morgantown, West Virginia 26506). Phys. Rev. D 12: No. 10, 3145-3158 (15 Nov 1975).

The quantum theory of the Yang-Mills field is formulated in terms of gauge-invariant, path-independent potentials and conjugate momenta. These nonlocal variables are a generalization to the non-Abelian case of the gauge invariants used by Dirac in his gauge-invariant formulation of quantum electrodynamics, and they are a path-independent, symmetrically ordered modification of the Mandelstam-displaced operators. The commutation relations, constraints, and equations of motion satisfied by the gauge invariants are derived from a canonical foundation and are seen to form Schwinger's consistent system of symmetrically factor-ordered gauge-field equations. The gauge invariance of the equations is manifest since only gauge-invariant quantities are involved. All equations are satisfied strongly, and if gauge-invariant operators are used to raise states from a gauge-invariant vacuum, nonphysical states will not be introduced into the theory. A simple relation holds between the local, canonical variables and the gauge invariants which allows the energy-momentum tensor density to be expressed either in terms of the canonical variables or the gauge invariants. Elimination of the local canonical variables in favor of the gauge invariants shows, from a different point of view, the origin of the nonclassical terms in Schwinger's Hamiltonian and equations of motion. It is shown that these terms are necessary in order to satisfy integrability conditions on the field equations. Working with the canonical variables permits a straightforward evaluation of the energy-momentum density commutators which are needed to verify the Lie-algebra relations of the inhomogeneous Lorentz group and the local conservation of the energy-momentum density operator. The inhomogeneous Lorentz-group boost-transformation equations are derived in a manner natural to the development given here. Schwinger's transformations are found and his assertion of Lorentz invariance is confirmed. (auth)

21906 QUANTUM MECHANICS OF EXTENDED OBJECTS IN RELATIVISTIC FIELD THEORY. Creutz, M. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 12: No. 10, 3126-3144 (15 Nov 1975).

We study canonical quantization of certain solutions of nonlinear classical field theories known as extended objects. These solutions are characterized by an energy density confined in a finite region of space for all time. We formulate a quantum theory in terms of the normal

modes of oscillation about a static solution and the couplings among these modes. A Feynman diagram prescription is given for calculating Green's functions of the fields in the presence of an extended object. We discuss the extension of the formalism to solutions exhibiting a steady rotation in some internal-symmetry space. Problems that may arise in applying the formalism to bag models for quark confinement are mentioned. (auth)

21907 LORENTZ-COVARIANT QUANTIZATION OF NONLINEAR WAVES. Klein, A.; Krejs, F. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. D 12: No. 10, 3112-3125 (15 Nov 1975).

The quantum theory of a real scalar field in one space dimension with quartic coupling is studied as an example of a field theory possessing exact classical solutions representing extended distributions of energy and momentum. It is shown how formal canonical quantization can be implemented in practice to obtain self-consistent, Lorentz-covariant descriptions of restricted portions of Hilbert space. This is done by deriving dynamical and kinematical sum rules from the equations of motion and commutation relations, respectively. These sum rules are shown to have a variational basis, which guarantees the consistency of the approach. Overall, we derive Lorentz-covariant generalizations of results found previously by Goldstone and Jackiw using the same approach, as well as some new results. (auth)

21908 MAGNETIC CHARGE AND THE CHARGE QUANTIZATION CONDITION. Schwinger, J. (University of California, Los Angeles, California 90024). Phys. Rev. D 12: No. 10, 3105-3111 (15 Nov 1975).

Two viewpoints concerning magnetic charge are distinguished: that of Dirac, which is unsymmetrical, and the symmetrical one, which embodies invariance under charge rotation. It is pointed out that the latter is not in conflict with the empirical asymmetry between electric and magnetic charge. The discussion is based on an action principle that uses field strengths and the vector potential A as independent variables; a second vector potential B is defined nonlocally in terms of the field strengths. This nonlocality is described by an arbitrary vector function $f^{\mu}(y)$, subject only to the restriction $\partial_{\nu} f^{\mu}(y) = \delta(y)$ and the additional requirement of oddness, in the symmetrical formulation. The charge quantization conditions for a pair of idealized charges, a and b, are inferred by examining the dependence of the action W on the choice of the arbitrary mathematical function f, and requiring the uniqueness of exp $[iW]$. For the unsymmetrical viewpoint the half-integer condition of Dirac is obtained, $e_a g_b/4\pi = n/2$, while the symmetrical formulation requires the integer condition $(e_a g_b - e_b g_a)/4\pi = n$. The Dirac injunction, "a string must never pass through a charged particle," is criticized as unnecessarily restrictive, owing to its origin in a classical action context. As simplified by a restriction to small momentum transfers, permitting the neglect of form-factor and vacuum-polarization effects, the dynamics of a realistic system of two spin-1/2 dyons is shown to involve the same interaction structure used in the idealized discussion. (auth)

21909 FINITE-TEMPERATURE PROPAGATORS FOR A SPONTANEOUSLY BROKEN FIELD THEORY. Dolan, L. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 12: No. 10, 3098-3104 (15 Nov 1975).

Renormalized expressions for finite-temperature propagators are obtained in both a weak-coupling and $1/N$ approximation to the O(N) model with negative mass squared and N real scalar fields. The weak-coupling results are given in spectral form. These Green's functions can be measured directly by allowing a weakly coupled interaction with an external probe. The singularity structure of the propagators is used to analyze the energy-momentum relation of the finite-temperature vacuum excitations, and the physical consequences of symmetry restoration are discussed. The renormalization prescription at zero temperature is sufficient for the finite-temperature theory in the broken-symmetry region as well as above the critical point. The tachyon found in the zero-temperature large-N limit remains at finite temperature but is now mixed in with normal spacelike singularities. (auth)

21910 A FIELD-THEORETIC STUDY OF THE REGGE-EIKONAL. II. Bartels, J. (National Accelerator Laboratory, Batavia, Illinois 60510). Ann. Phys. (N.Y.) 94: No. 1, 19-30 (19 Sept 1975).

A previous study of the Regge-eikonal model in ϕ^3 is extended to QED. First we define a reggeon amplitude that is built up by tower diagrams, and then study multi-regge exchange by use of Gribov's reggeon calculus. The situation is essentially the same as in ϕ^3: The eikonal approximation is the true high-energy and weak coupling limit ($s \to \infty$, $\alpha \ln s$=fixed), but it breaks down outside of the weak-coupling limit. This confirms that the eikonal approximation as a model for Regge-cuts is not justifiable by field-theoretic arguments because of the neglect of inelastic intermediate states. (auth)

21911 A FIELD-THEORETIC STUDY OF THE REGGE-EIKONAL MODEL. I. Bartels, J. (National Accelerator Laboratory, Batavia, Illinois 60510). Ann. Phys. (N.Y.) 94: No. 1, 1-18 (19 Sept 1975).

The Regge-eikonal model in ϕ^3 field theory is studied within the framework of Gribov's reggeon calculus. A condition is derived that indicates what sort of multi-reggeon exchange diagrams are important for large energies, and it is shown that the eikonal form is valid only in the weak-coupling limit, i.e., when the inner coupling constant of the reggeons goes to zero: $g^2 \sim 1/\ln s$. The breakdown of the eikonal approximation outside of this limit is shown to be an effect of inelastic intermediate states. (auth)

21912 ON THE DILUTE GAS TWO PARTICLE DENSITY MATRICES OF p-H_2 AND He_4. Weres, O. (University of California, Lawrence Berkeley Laboratory, Energy and Environment Division, Berkeley, California 94720). J. Chem. Phys. 64: No. 2, 848-850 (15 Jan 1976).

In the preceding paper we demonstrated that the reduced two particle density matrix of simple quantum liquids could profitably be re-expressed in terms of a Taylor expansion of its logarithm about the diagonal. In the present publication we examine the Taylor coefficients which arise when the dilute gas two particle density matrix is expanded in this way. In particular, we evaluate the leading coefficients of p-H_2 and He^4 exactly and extend the Wigner-Kirkwood approximation to provide approximate expressions for them. We demonstrate how these approximate expressions may be applied to yield results superior to those yielded by the ordinary Wigner-Kirkwood approximation. In an appendix we demonstrate how the Block equation for the dilute gas two particle density matrix may be reduced to an equivalent closed set of equations for the leading Taylor coefficients. (auth)

21913 CHARGE SHIELDING AND QUARK CONFINEMENT IN THE MASSIVE SCHWINGER MODEL. Coleman, S. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138); Jackiw, R.; Susskind, L. Ann. Phys. (N.Y.) 93: No. 1, 267-275 (5 Sept 1975).

The Schwinger model is quantum electrodynamics with massless fermions in two dimensions. It is known that the asymptotic states of the theory contain no states corresponding to free fermions ("quark trapping") and that local charge conservation is spontaneously broken ("Higgs phenomenon"). We investigate to what extent these phenomena persist when the fermion is given a bare mass. We find quark trapping but no Higgs phenomenon. The second of these results is dependent on mass perturbation theory; the first is not. (auth)

21914 SMALL VERTICAL OSCILLATIONS IN THE FIELD OF A ROTATIONALLY SYMMETRICAL POTENTIAL. Osipkov, L. P. (Leningrad State Univ.). Dokl. Akad. Nauk SSSR; 221: No. 2, 309-311(11 Mar 1975). (In Russian)

As is known, the problem of the motion of a material point in a given conservative field possessing rotational and mirror symmetries reduces to a two-dimensional one (because of the integral of areas), but in the general case it is not integrated in areas. This behavior makes it convenient to introduce a small parameter. A study is made of the motion near the symmetry plane of the potential by assuming the energy of the vertical oscillations to be small. Then as a first approximation it is assumed that the orbits are planar. Then the solution of the planar problem is substituted in the equations for the vertical motions, and the process is repeated. Thus the problem is analogous to the problem of the oscillations of a pendulum of variable length, which has been studied many times. By the introduction of canonical variables "action-angle" (J,Ψ) it is possible to simplify considerably the equations which turn out to be integrable over all orders of smallness. As a result it is possible to judge the stability of the plane motions and to calculate concrete, spacial orbits. (SJR)

21915 PROBLEM OF CAUSALITY IN CONFORMAL INVARIANT THEORIES. Kastrup, H. A. (Technische Hochschule, Aachen). pp 411-418 of Theories and Experiments in High-Energy Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975). See CONF-750110-P1.

This is a short review on the considerable progress made in the last year or so in the field of conformal invariant theories, especially as far as the problem of causality is concerned. (auth)

21916 COLLECTIVE PHENOMENA IN QUANTUM FIELD THEORY. Jackiw, R. (Massachusetts Inst. of Tech., Cambridge). Acta Phys. Pol., Ser.; B6: No. 6, 919-943(1975).

The discussion of collective phenomena in quantum field theory covers the quantum action, quantum meaning of static and time-dependent classical fields, and prospects for the theory. (JFP)

21917 ELECTRODYNAMICS OF DOUBLY CHARGED PARTICLES. Strazhev, V. I. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR; 19: No. 6, 495-497(Jun 1975). (In Russian).

A quantum theory for doubly charged particles (electric and magnetic charges) was constructed on the basis of a potential-free Mandelstam representation of quantum electrodynamics. A relation with the formulated theory using singular potentials was shown. (tr-auth)

21918 SUPERFLUIDS AS REPRESENTATIONS. Ruehl, W.; Yunn, B. C. (Univ. Trier, Kaiserslautern, Ger). Fortschr. Phys.; 23: No. 7, 431-449(1975).

Irreducible and reducible representations of the generalized Lie algebra of Wess and Zumino are studied. The algebra is integrated to a group with the help of Grassmann algebras and the representations of the algebra are made into representations of the group. Invariant sesquilinear forms are constructed that are positive definite for the Wess-Zumino algebra over the complex field. Irreducible superfields for any spin J are defined as specific realizations of such representations. All superfields appearing in the literature are either equivalent to one of these or built up out of these superfields.

21919 QUATERNIONIC FORM OF SUPERLUMINAL TRANSFORMATIONS. Imaeda, K. (Dublin Inst. for Advanced Studies). Lett. Nuovo Cim.; 15: No. 3, 91-92(17 Jan 1976).

The validity of a previous claim that a quaternionic transformation is the representation of a superluminal transformation in quaternion space and that all group properties of luminal and superluminal transformations hold for the corresponding quaternionic transformations. (JFP)

Gravitation and General Relativity

Refer also to abstracts 21001, 21052, and 21900.

21920 (EUR-5370e, pp 71-75) ELECTRONIC SIMULATION OF GRAVITATIONAL WAVE DETECTORS. Maeder, D. G.; Sanderson, B.; Sillou, A. (Univ., Geneva). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

In many fields of experimental physics, it is often useful to simulate an entire experiment by electronic means so that many experimental parameters may be varied at leisure. In the case of gravitational wave detection where near-optimum data processing is essential owing to the fact that the "supposed" signal is buried in the thermal Brownian noise of the detector, the construction of an electronic circuit which behaves like a detector of chosen parameters followed by a preamplifier with all the associated noise sources is entirely justified. In addition "gravitational wave signals" may be entered into the simulator at a certain level and hopefully recovered by the filtering and data processing system. Measurements of the efficiency of detection are then possible in function of the different noise sources and detector parameters. (auth)

21921 (EUR-5370e, pp 77-83) ELECTRONICS FOR THE IBM GRAVITY WAVE DETECTOR: CONCEPT, IMPLEMENTATION, AND EXPERIENCE. Levine, J. L.; Garwin, R. L. (IBM Watson Research Center, Yorktown Heights, NY). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In proceedings of 2nd Ispra nuclear electronics symposium.

The apparatus antenna, transducer, signal processor, and calibrator was designed to settle the question of the existence of gravity waves at 1.7 kHz of the numbers and intensities claimed at the time we began (end-1971). Thus the design criteria were: (1) modest sensitivity, (2) sensitivity independent of signal arrival time and state of excitation of the antenna, (3) absolute calibration with pulsed mechanical excitation of the antenna, (4) full simulation of the apparatus, and (5) hands-off computer analysis with every point published. It was recognized that a single bar would ultimately be limited by some Boltzmann distribution of noise at sub-thermal temperature (18 K for our bar at 300 K), and that such an ideal antenna would be equivalent to an ideal coincidence pair of antennas, each of half the mass. Transducer, amplifier, signal processor, and programming were all done by the experimenters in order to reduce the cycle time for introducing improvements. Before the antenna and amplifier were ready, the processing algorithms were developed and tested with digitally-simulated antenna output, and many problems avoided. Any excess local noise proved to be sufficiently infrequent so that the single antenna could negate claims by Weber of the detection of gravitational radiation. The computer processing obviated the need for temperature control of the antenna or for tracking of the bar resonant frequency with the reference oscillator (auth)

21922 GRAVITATIONAL RADIATION IN THE SCALAR-TENSOR THEORY OF GRAVITATION AND THE SEISMIC RESPONSE OF THE EARTH. Gurevich, L.E.; Dynkin, S.D. (Leningrad Physicotechnical Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 3, 319-321 (Mar 1975).

An investigation is made of the seismic response of the Earth to gravitational radiation of the scalar field emitted in accordance with the scalar-tensor theory of gravitation. Conditions are found under which this secondary radiation and the response to it are comparable with or exceed the corresponding values for the ordinary (primary) gravitational radiation in the general theory of relativity. It is shown that the angular dependence and polarization of the Earth's seismic response to the former are very different from its response to the latter. (auth)

21923 PAIR CREATION AND THE GOWDY MODEL. Winlove, C.P.; Raine, D.J. (Department of Astrophysics, South Parks Road, Oxford). Ann. Phys. (N.Y.) 93: No. 1, 116-124 (5 Sept 1975).

A new method of computing particle creation in a background gravitational field is applied to the minisuperspace Gowdy model and shown to give physically more reasonable results than the method of Hamiltonian diagonalization. (auth)

21924 UNIFICATION OF GAUGE AND GRAVITATION THEORIES. Tabensky, R. (Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile). J. Math. Phys. (N.Y.) 17: No. 1, 1-5 (Jan 1976).

A new approach to local Gauge theories is presented. The theory is developed in a curved space–time, and therefore gravitation is not neglected. Besides the Yang–Mills $A^a{}_\mu$ vector bosons associated with a symmetry group, scalar bosons $g_{\alpha\beta}$ appear just as naturally. The Lagrangian describing the interaction of these fields is the Ricci scalar for an extended Riemannian geometry. (auth)

21925 KILLING VECTORS IN EMPTY SPACE ALGEBRAICALLY SPECIAL METRICS. II. Held, A. (Institut für Theoretische Physik, Universität Bern, 3012 Bern, Switzerland). J. Math. Phys. (N.Y.) 17: No. 1, 39-45 (Jan 1976).

Empty space algebraically special metrics possessing an expanding degenerate principal null vector and Killing vectors are investigated. Attention is centered on that class of Killing vector (called nonpreferred) which is necessarily spacelike in the asymptotic region. A detailed analysis of the relationship between the Petrov–Penrose classification and these Killing vectors is carried out. (auth)

21926 WEYL CONFORM TENSOR OF $\delta=2$ Tomimatsu-Sato SPINNING MASS GRAVITATIONAL FIELD. Economou, J.E.; Ernst, F.J. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616). J. Math. Phys. (N.Y.) 17: No. 1, 52-53 (Jan 1976).

Extremely simple expressions are presented for the hitherto uncalculated invariants associated with the Weyl conform tensor of the $\delta=2$ Tomimatsu–Sato solution of Einstein's field equations. (auth)

21927 BLACK HOLES IN A MAGNETIC UNIVERSE. Ernst, F.J. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616). J. Math. Phys. (N.Y.) 17: No. 1, 54-56 (Jan 1976).

We present a general procedure for transforming asymptotically flat axially symmetric solutions of the Einstein–Maxwell equations into solutions resembling Melvin's magnetic universe. Specific applications yield metrics associated with black holes in a magnetic universe. It is hoped that these solutions will be of interest to astrophysicists studying gravitational collapse in the presence of strong magnetic fields. (auth)

21928 INFLUENCE OF A GRAVITATIONAL FIELD ON A ROTATING RING RESONATOR. Kuriyagawa, A.; Ihara, M.; Mori, S. (Faculty of Engineering, Keio University, Hiyoshi, Kohoku-ku, Yokohama, Japan 223). Phys. Rev. D 12: No. 10, 2955-2958 (15 Nov 1975).

It was concluded by Volkov and Kiselev that at low ring-resonator rotation velocities the beat frequency, due to a static gravitational field, is greater than the effect due to the resonator rotation. However, we show the nonexistence of the effect of a static gravitational field on the resonator's beat frequency, measured by proper time; proper time is always used for such measurements. (auth)

21929 QUANTIZATION OF A SCALAR FIELD IN THE KERR SPACETIME. Ford, L.H. (Department of Physics, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 12: No. 10, 2963-2977 (15 Nov 1975).

The interaction of a scalar field with the Kerr gravitational field is studied. The properties of the Klein-Gordon equation in the Kerr metric are reviewed, and a two-component formalism is developed. This formalism expresses the one-particle quantum theory for a massive scalar particle in the Kerr metric. A semiclassical analysis of the spontaneous emission of particles by a Kerr black hole is given. The quantization of a scalar field in the Kerr metric is developed, and a treatment of the spontaneous particle creation is given. The particular quantization given here leads to emission only into the classical superradiant modes and hence no emission by a Schwarzschild black hole. In the case in which $\omega M \ll 1$, where M is the mass of the black hole and ω the frequency of a given mode, an explicit expression may be given for the rate at which particles are emitted into each mode. In the case in which the particle's mass is zero and $a \ll M$, a = angular momentum per unit mass of the black hole, the total rate of loss of energy of the black hole is shown to be proportional to a^4/M^6. A discussion of the problem of the vacuum energy is given. It is shown that the energy of the vacuum state of a scalar field in a Kerr spacetime $a \ll M$ is the same as that for a Schwarzschild ($a = 0$) spacetime. (auth)

21930 ELECTROMAGNETIC PLANE-WAVE PERTURBATIONS IN KASNER COSMOLOGIES. Goorjian, P. (220 Jersey Street, San

Francisco, California 94114). Phys. Rev. D 12: No. 10, 2978-2983 (15 Nov 1975).

Maxwell's equations with no sources are solved for the vector potential of electromagnetic plane waves in a Kasner background spacetime (these fields are generally not null). By a transformation of the time coordinate, the one equation not identically zero is transformed into the Euler-Poisson-Darboux equation. The basic theory for this equation and its plane-wave solutions are presented. The stress-energy tensor due to these waves is computed in the limit as the singularity is approached. For some of the wave modes the stress-energy tensor introduces negligible source terms in the perturbation equations for the gravitational field. However, for other wave modes, the stress-energy terms in Einstein's gravitational field equations grow faster as the singularity is approached than the terms due to the Kasner background spacetime. Hence these wave modes perturb the Kasner background in an unstabilizing manner. (auth)

21931 ROTATING MODEL FOR THE EQUIVALENCE PRINCIPLE PARADOX. Wilkins, D.C. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 12: No. 10, 2984-2992 (15 Nov 1975).

An idealized system is described in which two inertial frames rotate relative to one another. When a (scalar) dipole is locally at rest in one frame, a paradox arises as to whether or not it will radiate. Fluxes of energy and angular momentum and the time development of the system are discussed. Resolution of the paradox involves several unusual features, including (i) radiation by an unmoving charge, an effect discussed by Chitre, Price, and Sandberg, (ii) different power seen by relatively accelerated inertial observers, and (iii) radiation reaction due to gravitational backscattering of radiation, in agreement with the work of C. and B. DeWitt. These results are obtained, for the most part, without the complications of curved space-time. (auth)

21932 NULL GEODESICS IN THE EXTENDED KERR MANIFOLD. Helliwell, T.M.; Mallinckrodt, A.J. (Department of Physics, Harvey Mudd College, Claremont, California 91711). Phys. Rev. D 12: No. 10, 2993-3003 (15 Nov 1975).

The behavior of null geodesics is analyzed for extended Kerr manifolds whose rotation and mass parameters satisfy the condition $0 \leq a^2 < m^2$. Geodesics are characterized by their impact parameters; radial and angular barriers, which restrict the motion, are derived in terms of these parameters. The radial barriers are used in determining the ultimate destination of null rays in the extended manifold. In agreement with previous work, there is a "throat" outside the event horizons, through which rays are admitted to the hole; we find in addition an "inner throat," which admits rays to negative radii. The boundary of each throat is determined for various intitial ray angles θ_0 for holes of particular rotation parameters. The cross-sectional area of the outer throat is rather insensitive to ray and hole parameters, but the inner throat is larger for rays with smaller θ_0 or for holes with larger rotation. The throat areas are related to the angular distributions of rays emerging from a hole into various regions of the manifold, after having initially converged upon the hole in a spherically symmetric manner. (auth)

21933 COSMOLOGY AND PARTICLE PAIR PRODUCTION VIA GRAVITATIONAL SPIN-SPIN INTERACTION IN THE EINSTEIN-CARTAN-SCIAMA-KIBBLE THEORY OF GRAVITY. Kerlick, G.D. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 12: No. 10, 3004-3006 (15 Nov 1975).

General relativity with spin and torsion [the Einstein-Cartan-Sciama-Kibble (ECSK) theory] provides a more complete account of local gauge invariance with respect to the Poincaré group than is possible in Einstein's general relativity. The ECSK theory introduces a new gravitational spin-spin contact interaction which is here shown to be repulsive between Dirac particles whose spins are aligned and attractive when spins are opposed. The presence of a Dirac field as source for the torsion causes a positive "effective mass" term in the energy condition of the generalized singularity theorem for this theory. The spin-spin interaction enhances rather than opposes singularity formation, in contrast with previous results for a convective spinning dust distribution. The strength of the interaction depends on number density, and for electron densities in excess of $\bar{\rho} \simeq 10^{47}$ g cm^{-3}, can cause particle pair production. (auth)

21934 ARE TORSION THEORIES OF GRAVITATION EQUIVALENT TO METRIC THEORIES? Sandberg, V.D. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. D 12: No. 10, 3013-3018 (15 Nov 1975).

An investigation is made of gravitation theories which are based on a Lagrangian constructed from the scalar curvature, in which torsion is allowed and in which the metric compatibility with the connection is not assumed in general. It is shown that because of the invariance of the scalar curvature under a projective transformation of the connection, only that part of the connection that is projectively invariant is determined by the theory. The theory is then reformulated so that the total action functional (gravitation plus source fields) depends only on the projective invariant part of the connection. The resulting theory is shown to be metrizable and equivalent to Einstein's theory with a modified source Lagrangian. (auth)

21935 SOME MAGNETIC AND ELECTRIC MONOPOLE ONE-BODY SOLUTIONS OF THE MAXWELL-EINSTEIN EQUATIONS. McGuire, P. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540); Ruffini, R. Phys. Rev. D 12: No. 10, 3019-3025 (15 Nov 1975).

We examine the electromagnetic structure of a one-body solution of the coupled Einstein-Maxwell equations endowed with mass m, charge Q, specific angular momentum a, and a parameter l. It is shown how the parameter l introduced by Newman, Tamburino, and Unti is related to the magnetic monopole charge distribution of the solution. A relation is presented between the total mass energy of the system and its irreducible mass. The total mass energy can be much smaller than the irreducible mass. A general solution characterized by the four parameters m, Q, a, and l is here introduced. (auth)

21936 METRIC OF TWO SPINNING CHARGED SOURCES ENDOWED WITH THE NEWMAN-TAMBURINO-UNTI PARAMETER. McGuire, P. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540); Ruffini, R. Phys. Rev. D 12: No. 10, 3026-3029 (15 Nov 1975).

Following the approach of Israel, Wilson, and Perjes we give the explicit form of the metric corresponding to two Kerr-Newman sources in equilibrium endowed with opposite values of the Taub-Newman-Tamburino-Unti parameters. The two solutions have equally and oppositely directed spin vectors. The explicit structure of the electromagnetic fields is given for the case, where the two sources are separate and in the limit their separation goes to zero (coalescence). The asymptotic form of the metric is regular for $r \to +\infty$; and when the separation of the two solutions is not zero the electromagnetic field asymptotically approaches an electric monopole and a magnetic dipole field. (auth)

21937 INTERNAL STRUCTURE OF MULTICOMPONENT STATIC SPHERICAL GRAVITATING FLUIDS. Olson, E.; Bailyn, M. (Physics Department, Northwestern University, Evanston, Illinois 60201). Phys. Rev. D 12: No. 10, 3030-3036 (15 Nov 1975).

The Maxwell-Einstein equations for a fluid comprised of more than one type of particle are not a determinate system even if an equation of state is added. The problem of what the charge distribution is in such fluids is therefore also not determinate. To complete the definition of the problem, more equations are needed. We obtain these for the simple case of a static spherically symmetric multicomponent system (imbedded in a Minkowskian background) by minimizing the energy of the fluid with respect to variations in the number densities of the constituents, with the side conditions that the total number of each constituent is constant during the variations. This procedure results in a determinate set of hydrostatic equilibrium equations, the sum of which is the familiar Tolman-Oppenheimer-Volkoff equation. Some general conclusions can be drawn. For example, the necessary and sufficient condition for charge neutrality is that the mass-energy density be some (arbitrary) function of some (arbitrary) *linear* combination of the number densities. Thus since it is well known that the electrons in a white dwarf star at absolute zero form a degenerate gas, there *must* be a charge imbalance throughout such a star. This imbalance can then be computed self-consistently. An over-all physical interpretation of the new equations is that in equilibrium at any point in the fluid the sum of the *non*gravitational forces per unit energy is the same for constituent 1 as for constituent 2 and so on. This is the analog of the corresponding (Galilean) statement for gravitational forces that is valid even without equilibrium. (auth)

21938 A SOLUTION OF COUPLED EINSTEIN-SO(3) GAUGE FIELD EQUATIONS. Wang, M.Y. (Center for Theoretical Studies, University of Miami, Coral Gables, Florida 33124). Phys. Rev. D 12: No. 10, 3069-3071 (15 Nov 1975).

A solution of the coupled Einstein-SO(3) gauge field equations is presented. The solution is shown to have an event horizon. Thus it is a black-hole solution. The existence of this solution indicates that black holes may carry the signature of gauge charge. (auth)

21939 GRAVITATIONAL COLLAPSE OF MARGINALLY BOUND SPHEROIDS: INITIAL CONDITIONS. Eardley, D.M. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 12: No. 10, 3072-3076 (15 Nov 1975).

A method is given for solving the general relativistic initial-value problem in the case of some collapsing, marginally bound, nonrotating configurations. Explicit solutions are found for oblate and prolate spheroids. Maximum efficiency limits for subsequent gravitational radiation are 2.5% (oblate) and 3.4% (prolate) for spheroids so compact that they lie within an apparent horizon on the initial slice. (auth)

21940 LORENTZ-COVARIANT DESCRIPTION OF WEAK GRAVITATIONAL FIELDS. Vallander, S. V. (Leningrad State Univ.). Dokl. Akad. Nauk SSSR; 221: No. 2, 295-298(11 Mar 1975). (In Russian)

The known results, dealing with the study of a three-dimensional acceleration vector a of a certain, electrically neutral point mass

m, in the nonrelativistic case can be formulated in the form of the following assertions: the vector a does not depend on the magnitude of the mass m; the vector a is a linear function of the components of the velocity vector v with which the mass m moves; the part of the acceleration a, depending on the velocity v, can be represented in the form of a vector product of v multiplied by a pseudovector. All these facts can be described in the form of the formula: a = G + (vR/c). Here the vector G and the pseudovector R have the dimensions of acceleration, if c designates a quantity having the dimensions of velocity (velocity of light in vacuum). This study shows that for a certain class of weak noninertial system of coordinates it is possible to obtain a Lorentz-covariant (relativistic) description of the field of a four-dimensional, acceleration vector w of a free, electrically-neutral mass. It is shown that these equations give the same results obtained by Newton's theory of gravitation. (SJR)

21941 PROSTRANSTVO–VREMYA I FIZICHESKOE POZNANIE. (Space–Time and Physical Knowledge). Mostepanenko, A. M. Moscow; Atomizdat (1975). 216p.

An analysis of contemporary space-time concepts, a determination of possible directions for generalizing these concepts, and their methodological development and comparison represent at present one of the main problems of philosophical and physical studies in field theory, the physics of elementary particles and cosmology. The problem of selecting from a set of chronogeometric models that one which correctly reflects the real space-time relations of the world is analyzed from a new point of view. Barriers are overcome in solving this problem, that are associated with the particular "supplementary quality" of geometry and physics noted by Poincare. The general methodological conclusions are applicable to all the basic, contemporary, physical theories: special relativity theory and general relativity theory in their various interpretations (chronogeometrics, tetrad theory of gravitation, etc.), quantum mechanics, quantum electrodynamics, theories of strong and weak interactions, relativistic cosmology and others. 251 references. (SJR)

21942 GRAVITATION AND THE STRUCTURE OF MATTER. Pepin, R. L. St. Louis; St. Louis Univ. (1974). 59p. University Microfilms Order No. 75-26,301.

Thesis (Ph. D.).

The implications of the principle of the equivalence of mass and energy for Newton's theory of motion and gravitation are first examined. Because of the postulated equality between inertial and gravitational mass, this procedure is unambiguous and leads to a derivation of the gravitational field equations R/sub mu nu/ equals 0, where R/sub mu nu/ is the Ricci tensor. In an effort to account for the nature and structure of matter itself, field equations are proposed from which it follows that the curvature R of space-time satisfies a Klein-Gordon type wave equation a^2 square ^{2}R + R equals 0. Here a is a new universal constant having the dimension of length. An appropriate energy-momentum tensor is constructed. An exact solution of the proposed field equations is obtained for the case of static spherical symmetry. A feature of the solution is the quantization of charge, which establishes the following numerical relation: 0.696a equals alpha/sup $\frac{1}{2}$/L, where alpha is the fine structure constant and L is the Planck length root(dirac constant gamma/c^3). The present findings suggest the possibility that when the field equations are solved for the case of stationary axial symmetry corresponding to the Kerr-Newman metric, the solution may provide a satisfactory explanation of the static properties of an isolated electron. (Diss. Abstr. Int., B)

21943 INTRODUCTION TO MODERN THEORETICAL PHYSICS. Volume I, Classical Physics and Relativity. Harris, E. G. New York; John Wiley and Sons, Inc. (1975). 405p.

The treatment covers vectors, tensors, and the structure of space, Newton's laws of motion and the law of gravitation, analytical mechanics, oscillatory motion, mechanics of a rigid body and of continuous media, classical fields, electromagnetic waves and radiation, the principle of relativity, relativistic electrodynamics and mechanics, general relativity theory and some of its consequences, and unified field theories and other modifications of the general theory of relativity. (JFP)

REACTOR TECHNOLOGY AND REGULATION

21944 (ANL-CT-76-23) DYNAMIC SIMULATOR FOR NUCLEAR POWER PLANTS (DSNP). Saphier, D. (Argonne National Lab., Ill. (USA)). Jan 1976. 36p. Dep. NTIS $4.00.

A new simulation language DSNP (Dynamic Simulator for Nuclear Power Plants) is being developed. It is a simple block oriented simulation language with an extensive library of component and auxiliary modules. Each module is a self-contained unit of a part of a physical component to be found in nuclear power plants. Each module will be available in four levels of sophistication, the fourth being a user supplied model. A module can be included in the simulation by a single statement. The precompiler translates DSNP statements into FORTRAN statements, takes care of the module parameters and the intermodular communication blocks, prepares proper data files and I/O statements and searches the various libraries for the appropriate component modules. The documentation is computerized and all the necessary information for a particular module can be retrieved by a special document generator. The DSNP will be a flexible tool which will allow dynamic simulations to be performed on a large variety of nuclear power plants or specific components of these plants. (auth)

21945 (CONF-750117-P1, pp 99-109) ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANT PROJECTS IN FOREIGN COUNTRIES. Brush, H. F. (Bechtel Power Corp., San Francisco). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The role of the engineer-constructor in the U. S. nuclear power industry is reviewed. The current development of this role is also discussed. The entry of the engineer-constructor into the international nuclear power plant market is discussed. (JWR)

21946 (CONF-750117-P1, pp 111-122) TAIPOWER'S NUCLEAR POWER PROGRAM, 1969-1985. Chu, D. S. L. (Taiwan Power Co., Taipei). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The development program for nuclear power in Taiwan is reviewed. Topics discussed include reasons for the nuclear choice, siting, unit size, reactor type selection, finances, fuel supply, and manpower. (JWR)

21947 (CONF-750117-P1, pp 469-530) APPLICATIONS OF A SIMULATION MODEL (ORSIM) TO ELECTRIC GENERATION PLANNING IN TAIWAN, REPUBLIC OF CHINA. Scarborough, J. C. (NUS Corp., Rockville, MD); Turnage, J. C. 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The strategic optimization of the Taipower system over a mid-range period from 1980 to 1985 is examined with particular attention to the scheduling of nuclear plant refuelings, the scheduling of thermal plant maintenance outage, the optimum utilization of nuclear, hydro, and pumped-storage energy, and the effect of various system perturbations on system costs. The assessments have been performed with the aid of the ORSIM program, a computer code for the simulation and optimization of utility system operation with nuclear plants. (auth)

21948 (CONF-750117-P2, pp 951-956) PRESENT STATUS OF THE NUCLEAR POWER DEVELOPMENT IN JAPAN. Takeda, E. (Japan Atomic Industrial Forum, Tokyo). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The development of nuclear power in Japan is reviewed. The scheduled operation program for plants completed and under construction is described. Some of the difficulties which have been encountered are briefly discussed. (JWR)

21949 (CONF-750117-P2, pp 989-1031) ROLE OF NATIONAL TSING HUA UNIVERSITY IN THE NATIONAL DEVELOPMENT OF NUCLEAR POWER. Cheng, C. H.; Yang, C. M.; Yeh, S. J.; Tseng, D. L.; Weng, P. S.; Yang, M. H.; Yuan, L. J. (National Tsing Hua Univ., Hsinchu, Taiwan). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The education programs at the National Tsing Hua University related to nuclear technology are described The efforts at providing trained personnel for the country's nuclear power program are discussed. (JWR)

21950 (CONF-750117-P2, pp 1033-1063) TAIPOWER NUCLEAR POWER STAFFING AND TRAINING. Chu, B. P. H.; Lu, T. C. (Taiwan Power Co., Taipei). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The Taipower nuclear training program during the preparatory period for nuclear power plants is reviewed. This training included both academic and on-the-job training. It was conducted in countries with more developed nuclear industry. The staffing for Taipower nuclear projects is described and current in-house training programs are discussed. (JWR)

21951 (IRS-W-15(9-75)) DESIGN OF NUCLEAR INSTALLATIONS AGAINST EXTERNAL EFFECTS. Appearance and Propagation of Pressure Waves During the Penetration of a Body in Water. Drittler, K.; Gruner, P.; Schier, H. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F.R. Germany)). Sep 1975. 40p. (In German). Dep. NTIS (US Sales Only) $4.00.

A method is given for calculating the pressure waves which arise from a body penetrating into water. A model for determining the generation of the pressure wave during the penetration process of the body is developed and the propagation of the wave is calculated. The results are applied to the crash of an airplane into the waters in front of an intake structure leading to short and intense shocks for the building and its components. (auth)

21952 CLOSED-CYCLE ENERGY SUPPLY. Schulten, R.; Bernert, H. VDI (Ver. Dtsch. Ing.) Ber.; No. 224, 23-35(1974).

A heat energy supply system is described in which a helium cooled reactor supplies heat to a chemical reactor where the heat energy is changed into latent chemical energy of hydrogen and carbon monoxide in the reaction $CH_4 + H_2O \rightarrow 3H_2 + CO$. The latent gases are transferred to a second chemical reactor where the chemical energy is changed to hot water or steam in the reaction $3H_2 + CO \rightarrow CH_4 + H_2O$. The CH_4 is transferred back to the first chemical reactor to be used for H_2 and CO production. (TSS)

21953 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY 1975 WINTER MEETING, SAN FRANCISCO, CALIFORNIA, NOVEMBER 16-21, 1975. Farmakes, R. (ed.). Trans. Am. Nucl. Soc.; 22: 1-836(Nov 1975).

Each of the brief summaries of the papers presented at the meeting is listed by title in NSA. The summaries cover sessions on civil explosion application, controlled fusion, environmental sciences, isotopes and radiation, materials, mathematics, criticality safety, fuel cycle, reactor technology, remote systems technology, shielding, and dosimetry. (HDR)

For abstracts of individual papers see: 19663-19671, 19691, 19707, 19734, 19775-19782, 19795-19799, 19827, 19883-19889, 19934-20022, 20052-20054, 20093-20096, 20157-20159, 20170, 20200, 20201, 20226, 20241, 20272-20282, 20288, 20289, 20309, 20382, 20428-20430, 20444-20451, 20468-20472, 20512, 20513, 20587-20593, 20640-20642, 20701-20703, 20787, 20788, 20852-20861, 20880, 20893-20897, 20899-20908, 20921-20925, 20928-20953, 20955-20958, 20985-20988, 21126, 21564-21583, 21627, 21702-21711, 21779, 21814-21818, 21835-21842, 21844-21851, 21954-21973, 21980-21995, 22004-22036, 22046-22057, 22077-22079, 22107-22215, 22226-22274, 22302, 22337-22479, 22484-22514, 22552-22563, 22586-22597, 22601-22608, 22616-22624, 22632-22638, 22642-22671, 22684-22689, and 22694-22696.

21954 NUCLEAR ENGINEERING LABORATORY. Roberts, D. M. (Iowa State Univ., Ames). Trans. Am. Nucl. Soc.; 22: 84-85(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21955 UNIVERSITIES' ROLE IN MID-CAREER TRAINING OF NUCLEAR ENGINEERS. Eichholz, G. G. (Georgia Inst. of Tech., Atlanta). Trans. Am. Nucl. Soc.; 22: 87(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21956 MID-CAREER TRAINING PROGRAMS AT MIT. Hansen, K. F.; Tribus, M. (Massachusetts Inst. of Tech., Cambridge). Trans. Am. Nucl. Soc.; 22: 87-88(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21957 NUCLEAR FUEL CYCLE EDUCATION AT MISSISSIPPI STATE UNIVERSITY. Reynolds, R. S. (Mississippi State Univ., State College). Trans. Am. Nucl. Soc.; 22: 90-91 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21958 NUCLEAR FUEL CYCLE ACADEMIC PROGRAM AT MIT. Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge). Trans. Am. Nucl. Soc.; 22: 91(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21959 NUCLEAR FUEL CYCLE EDUCATION AT GEORGIA TECH. Carlson, R. W.; Clement, J. D. (Georgia Inst. of Tech., Atlanta). Trans. Am. Nucl. Soc.; 22: 91-92(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21960 UTILITY OBJECTIVES IN FUEL CYCLE MANAGEMENT. Shen, P. K. (Joint Center for Graduate Study, Richland, WA). Trans. Am. Nucl. Soc.; 22: 92-93(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21961 FUEL CYCLE CURRICULUM AT PURDUE UNIVERSITY. Fulford, P. J.; Gallar, O. H. (Purdue Univ., West Lafayette, IN). Trans. Am. Nucl. Soc.; 22: 93(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21962 USE OF MINICOMPUTERS AT WESTINGHOUSE-NES. Dannels, R. A.; Steer, R. W. (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 287(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21963 EFFECTIVE USE OF MINICOMPUTERS AND MAXICOMPUTERS IN THE NUCLEAR INDUSTRY. Fernbach, S. (Univ. of California, Livermore). Trans. Am. Nucl. Soc.; 22: 287-288(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21964 MINICOMPUTERS IN NUCLEAR ENGINEERING EDUCATION. Harmer, D. S. (Georgia Inst. of Tech., Atlanta). Trans. Am. Nucl. Soc.; 22: 288-289(Nov 1975).
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21965 ESTIMATING FUTURE ELECTRICITY DEMAND IN AN ERA OF INCREASING ENERGY SCARCITY. Chern, W. S.; Gill, G. S.; Carlsmith, R. S. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 544(Nov 1975).
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21966 FORECASTS OF ELECTRICAL DEMAND. Chamberlin, J. H. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 547-548(Nov 1975).
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21967 VERY HIGH TEMPERATURE REACTOR FOR PROCESS HEAT. Ravets, J. M.; Tobin, J. M. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 599-600(Nov 1975).
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21968 INCREASING POWER PLANT PRODUCTIVITY: A STATUS REPORT. Keller, R. W.; Smith, M. J. (Mechanics Research Inc., Los Angeles). Trans. Am. Nucl. Soc.; 22: 609-611(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21969 MANAGEMENT CONTROL SYSTEM FOR MAJOR OVERHAULS, REPAIRS, OR MODIFICATIONS. Chando, J. J., Jr.; Hendricks, J. R. (Burns and Roe, Paramus, NJ). Trans. Am. Nucl. Soc.; 22: 615(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21970 CASE FOR VOLUNTARY RECIPROCAL INSPECTION BETWEEN NUCLEAR POWER STATIONS. Ross, S. R. (Public Service Co. of Colorado, Denver). Trans. Am. Nucl. Soc.; 22: 617-618(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21971 COMPUTERIZED/MULTIPLEXED RADIATION MONITORING SYSTEM. Hekkala, B.; Union, D. C. (General Atomic, San Diego, CA). Trans. Am. Nucl. Soc.; 22: 643-644(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21972 IN-CORE NEUTRONIC AND THERMAL MEASUREMENTS AS A SOURCE OF MULTIPLE USEFUL OPERATING DATA. Fenech, H. (Univ. of California, Santa Barbara). Trans. Am. Nucl. Soc.; 22: 649-650(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21973 EXAMINATION OF ALBEDO TECHNIQUES IN RADIATION SHIELDING ANALYSIS: APPLICATION TO REACTOR CAVITY STREAMING PROBLEMS. Simmons, G. L. (Science Applications, Inc., Huntsville, AL); Albert, T. E.; Ziskind, R. Trans. Am. Nucl. Soc.; 22: 806-808(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21974 WURENLINGEN REACTOR INSTITUTE (EIR). Technica (Basel); 23: No. 20, 1741-1744(Oct 1974). (In German)
An account is given of the history and organization of the Swiss Erdgenoessisches Institut fuer Reaktorforschung (which became well-known for its swimming-pool reactor in 1957), and of its current R & D activities. (Electr. Electron Abst.)

21975 REPORT AND ACCOUNTS OF THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY FOR THE YEAR ENDED 31 MARCH 1975. London; United Kingdom Atomic Energy Authority (1975). 80p. £1.25.
The report is in three sections: the first is a general survey of nuclear power development, work outside the nuclear power field, finance and staff; the second section deals in more detail with the several reactor programs being pursued by the Authority, and also covers nuclear safety and the environment, R & D contract work for the nuclear industry, controlled nuclear fusion, and underlying research; the third section deals with the non-nuclear program and the applied nuclear program (including radioactive tracer techniques and electrotechnology). Appendices contain lists of the Authority's senior staff, reactors, major facilities and establishments. The accounts for the year are presented. (UK)

21976 NUCLEAR AND GEOTHERMAL ENERGY FOR DIRECT HEAT SUPPLY. Field, A. A. Energy World; No. 22, 5-8(Dec 1975).
The feasibility of supplying process heat, or heat for district heating, from small, relatively low temperature nuclear reactors of the swimming pool type has been investigated. Such reactors are safe and reliable and, on account of the higher oil prices, fairly small units (200-300 MW) might now be practical. Heating load curves are studied from the point of view of optimizing reactor and auxiliary heating facilities, optimizing heat storage, or hydrogen storage (with the hydrogen produced during off peak periods and stored until needed). In some areas the possibilities of using geothermal energy for district heating are attractive and the methods used are treated briefly. (LTN)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 19775, 20217, 20239, 22304, 22311, 22318, 22319, 22325, 22329, 22332, 22337, 22340–22342, 22344–22346, 22430–22432, 22434, 22435, 22437, 22458, 22467, 22470, 22477, 22602, 22603, and 22606.

21977 (CONF-750117-P1, pp 303-352) INTERRELATIONSHIPS BETWEEN NUCLEAR FUEL DESIGN, PERFORMANCE, AND FABRICATION. Bement, A. L. (Massachusetts Inst., of Tech., Cambridge). 1975.
From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).
In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

Several factors which indicate that LWR nuclear fuel design and fabrication are still undergoing active technical evolution are described. Some aspects of design and fabrication technology where additional research and development are needed are discussed. The highly interactive nature of design and fabrication development is examined. (JWR)

21978 (CONF-750117-P1, pp 371-377) ENGINEERING AND CONSTRUCTION MANAGEMENT: TAIPOWER NUCLEAR POWER PLANTS. Lin, C. N. (Taiwan Power Co., Taipei). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The engineering and construction technical management for construction of the Chinshan and Kuosheng Nuclear Power Stations is described. (JWR)

21979 (CONF-750117-P1, pp 565-598) PRELIMINARY STUDY OF USING PuO_2/ThO_2 AS A MAKE-UP FUEL IN A TYPICAL BOILING WATER REACTOR. Ho, C. Y.; Ho, S. L. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The feasibility of using oxides of Pu and Th (designated PuO_2/ThO_2) as make-up fuel in a typical BWR is investigated. The dimensions of the make-up fuel are assumed to be the same as that of UO_2. Thirty assemblies of PuO_2/ThO_2 fuel are fed into each cycle after the 8th fuel cycle. The physics calculations follow the reactor through the whole running-in period from the first core to the equilibrium state. The physics of the PuO_2/ThO_2 fuel is compared in detail to a similar reactor using UO_2 as make-up fuel, as presently planned. The evaluation of fuel cycle costs is performed with present worth methods calculating both quasi-equilibrium and equilibrium costs for the reactor lifetime. PuO_2/ThO_2 fuel has some advantages over UO_2 but imposes some penalty in fuel cycle cost. The economic comparison between PuO_2/ThO_2 and UO_2 as a BWR make-up fuel thus depends largely on the Pu value. (auth)

21980 CHEMISTRY OF RADIOACTIVE DEPOSITS AND LABORATORY DECONTAMINATION OF SPECIMENS FROM BWR AND PWR NUCLEAR PLANTS. Anders, O. U. (Dow Chemical Co., Midland, MI). Trans. Am. Nucl. Soc.; 22: 121 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21981 SUSTAINED LOAD CRACK GROWTH IN A533-B-1 STEEL UNDER NEUTRON IRRADIATION IN A WATER ENVIRONMENT. Gupta, M. C.; Hoeppner, D. W.; Meyer, W. (Univ. of Missouri, Columbia). Trans. Am. Nucl. Soc.; 22: 202-203(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21982 IN-REACTOR DENSIFICATION OF UO_2. Stora, J. P.; Bruet, M. (CEN, Grenoble, France). Trans. Am. Nucl. Soc.; 22: 206-207(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

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From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21984 AMMONIA SUPPRESSES OXYGEN PRODUCTION IN BOILING WATER REACTORS. LeSurf, J. E.; Allison, G. M. (Atomic Energy of Canada Limited, Chalk River, Ont.). Trans. Am. Nucl. Soc.; 22: 550(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21985 BYPASS FLOW DISTRIBUTION IN A BOILING WATER REACTOR. Gott, D. R.; Carlson, R. W. (Georgia Inst. of Tech., Atlanta). Trans. Am. Nucl. Soc.; 22: 581-582(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21986 BWR ANALYTICAL MODEL: AN OPERATIONS AID TO AVAILABILITY. Rubino, L. (Philadelphia Electric Co.); Hunt, K.; Fisher, J.; Kendrick, E.; Ho, J. Trans. Am. Nucl. Soc.; 22: 611-612(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21987 EVOLUTION OF A LARGE PWR LIQUID RADWASTE SYSTEM. O'Brien, D. E.; Schumann, C. E. (Commonwealth Edison Co., Zion, IL). Trans. Am. Nucl. Soc.; 22: 615-616 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21988 BWR STS: IS A BETTER "MODUS OPERANDI" POSSIBLE. Johnson, R. J. (Georgia Power Co., Atlanta). Trans. Am. Nucl. Soc.; 22: 618-619(Nov 1975).

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21989 CORE COMPONENT VIBRATION MONITORING IN BWRs USING NEUTRON NOISE. Fry, D. N.; Robinson, J. C.; Kryter, R. C.; Cole, O. C. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 623-624(Nov 1975).

From Americal Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21990 DIAGNOSIS OF IN-CORE INSTRUMENT TUBE VIBRATIONS IN BWR-4s. Ackermann, N. J. Jr. (Oak Ridge National Lab., TN); Fry, D. N.; Kryter, R. C.; Sides, W. H. Jr.; Robinson, J. C.; Mott, J. E.; Atta, M. A. Trans. Am. Nucl. Soc.; 22: 624-625(Nov 1975).

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21991 ENVIRONMENTAL MONITORING AT QUAD CITIES NUCLEAR GENERATING STATION. Bernhard, H. F.; Hughes, J. H. (Commonwealth Edison Co., Chicago). Trans. Am. Nucl. Soc.; 22: 632-633(Nov 1975).

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21992 POWER DISTRIBUTION MONITORING AT THE YANKEE REACTORS. Pilat, E. E.; Cacciapouti, R. J.; Denver, D. J.; VerPlanck, D. M. (Yankee Atomic Electric Co., Westboro, MA). Trans. Am. Nucl. Soc.; 22: 646-647(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21993 TECHNIQUES FOR UNDERSTANDING IN-CORE DETECTOR TUBE VIBRATIONS. Thie, J. A. Trans. Am. Nucl. Soc.; 22: 689-690(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21994 THORIUM–URANIUM FUELING FOR LIGHT-WATER REACTORS. Lang, L. W. (Pacific Nuclear Fuels, Inc., Richland, WA). Trans. Am. Nucl. Soc.; 22: 706(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21995 RELIABILITY AND ECONOMICS OF LIGHT-WATER REACTORS. Rossin, A. D. (Commonwealth Edison Co., Chicago); Minnick, L. E.; Prestele, J. Trans. Am. Nucl. Soc.; 22: 833 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

21996 REACTOR COOLANT PUMP FLYWHEEL OVERSPEED EVALUATION. Riccardella, P. C.; Bamford, W. H. (General Atomic Co., San Diego, CA). J. Pressure Vessel Technol.; 96: No. 4, 279-285(Nov 1974).

The overspeed capability of the large steel flywheels used on light water reactor primary coolant pumps has been evaluated through a combined analytical and experimental effort. Limiting speeds of the prototype flywheel design were calculated for the ductile failure mode using the principles of Section III of the ASME Boiler and Pressure Vessel Code, and for the brittle fracture mode using a fracture mechanics approach in which stress intensity factors were determined from finite element computer analysis. The accuracy of the analytical approach was verified by a scale model test program which demonstrates excellent agreement between experiment and analysis. The results of the evaluation are presented, and they illustrate the kinds of things which can be accomplished through application of modern fracture mechanics technology, including plasticity considerations, to the solution of hardware problems of real engineering interest. (auth)

21997 METHOD FOR INCREASING THE BURN-UP CAPABILITY OF BOILING WATER NUCLEAR REACTORS CONTAINING PLUTONIUM-BEARING FUEL ASSEMBLIES. Sofer, G. A. (to General Atomic Co.). US Patent 3,910,818. 7 Oct 1975. Filed Date 30 Oct 1969. 6p.

The burn-up capability of a boiling water nuclear reactor containing plutonium-bearing fuel assemblies is significantly increased by reducing the void fraction in the core toward the end of the cycle. This reduction is advantageously accomplished by increasing the rate at which water is recirculated. (Official Gazette)

21998 METHOD AND APPARATUS FOR REMOVING RADIOACTIVE GASES FROM A NUCLEAR REACTOR. Frumerman, R.; Brown, W. W. (to Westinghouse Electric Corp.). US Patent 3,910,817. 7 Oct 1975. Filed Date 17 Oct 1972. 6p.

A description is given of a method for removing radioactive gases from a nuclear reactor including the steps of draining coolant from a nuclear reactor to a level just below the coolant inlet and outlet nozzles to form a vapor space and then charging the space with an inert gas, circulating coolant through the reactor to assist the release of radioactive gases from the coolant into the vapor space, withdrawing the radioactive gases from the vapor space by a vacuum pump which then condenses and separates water from gases carried forward by the vacuum pump, discharging the water to a storage tank and supplying the separated gases to a gas compressor which pumps the gases to gas decay tanks. After the gases in the decay tanks lose their radioactive characteristics, the gases may be discharged to the atmosphere or returned to the reactor for further use. (Official Gazette)

21999 EFFECTS OF FISSILE ATOM SEGREGATION IN LIGHT WATER REACTOR PLUTONIUM RECYCLE FUELS. Meyer, R. O. (Nuclear Regulatory Commission, Washington, DC); Hann, C. R.; Lanning, D. D. Nucl. Technol.; 27: No. 3, 389-393(Nov 1975).

Plutonium segregation during normal operation is not expected in light water reactor (LWR) plutonium recycle fuels, but it could occur if these fuels were operated in a sustained overpower condition. Existing thermal performance and neutronic computer codes have been used to compare the effects of postulated segregation with the behavior of homogeneous fuels. Central void formation, which should accompany plutonium segregation, reduces fuel temperatures markedly; but even if a central void is assumed not to form, the fuel's centerline temperature, stored energy, and melting point are not significantly affected by the postulated segregation. It is concluded that plutonium segregation is not an important phenomenon in LWR plutonium recycle fuels. (auth)

22000 METHOD FOR OPTIMUM DETERMINATION OF ADJUSTABLE PARAMETERS IN THE BOILING WATER REACTOR CORE SIMULATOR USING OPERATING DATA ON FLUX DISTRIBUTION. Kiguchi, T.; Kawai, T. (Atomic Energy Research Lab., Tama, Japan). Nucl. Technol.; 27: No. 3, 315-326(Nov 1975).

A method has been developed to optimally and automatically determine the adjustable parameters of the boiling water reactor three-dimensional core simulator FLARE. The steepest gradient method is adopted for the optimization. The parameters are adjusted to best fit the operating data on power distribution measured by traversing in-core probes (TIP). The average error in the calculated TIP readings normalized by the core average is 0.053 at the rated power. The k-infinity correction term has also been derived theoretically to reduce the relatively large error in the calculated TIP readings near the tips of control rods, which is induced by the coarseness of mesh points. By introducing this correction, the average error decreases to 0.047. The void-quality relation is recognized as a function of coolant flow rate. The relation is estimated to fit the measured distributions of TIP reading at the partial power states. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 19775, 19778, 20224, 21977, 21980–21983, 21992, 21994–21996, 21999, 22050, 22304, 22307, 22318, 22319, 22325, 22328, 22332, 22337, 22339–22346, 22430–22435, 22437, 22450–22458, 22470, 22473, 22475, 22476, and 22603.

22001 (ANCR-1270) USNRC-OECD HALDEN PROJECT FUEL BEHAVIOR TEST PROGRAM: EXPERIMENT DATA REPORT FOR TEST ASSEMBLIES IFA-226 AND IFA-239. Laats, E. T.; MacDonald, P. E.; Quapp, W. J. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Dec 1975. Contract E(10-1)-1375. 235p. Dep. NTIS $10.00.

The experimental data which were obtained from the IFA-226 and IFA-239 test assemblies during operation in the Halden Boiling Water Reactor are reported. Included are cladding elongation, fuel centerline temperature, internal gas pressure, and power history data from IFA-226 which were obtained from November 1971 through April 1974, and cladding elongation, diametral profile, and power history data from IFA-239 covering the period from March 1973 through April 1974. The data, presented in the form of composite graphs, have been analyzed only to the extent necessary to assure that they are reasonable and correct. A description of these mixed oxide fuel test assemblies and their instrumentation is presented. Test pin fabrication history, instrument calibration data, assembly power calibration methods, and the neutron detector data reduction technique are included as appendices. (auth)

22002 (CENPD-198) ZIRCALOY GROWTH: IN-REACTOR DIMENSIONAL CHANGES; IN ZIRCALOY-4 FUEL ASSEMBLIES. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Dec 1975. 34p. Combustion Engineering, Inc., Windsor, CT.

The position of Combustion Engineering (C-E) on the in-reactor growth of Zircaloy-4 fuel assembly components is described. A model relating growth strain to neutron fluence is developed by empirical fit. The data base is divided into three groups to reflect the difference between annealed and cold worked material and to separate fuel rods from non-fueled specimens. A literature discussion of the proposed mechanisms of irradiation growth is included in support of the empirical model. (auth)

22003 (CONF-750117-P2, pp 971-976) PRESENT STATUS OF Ko-Ri NUCLEAR POWER PLANT CONSTRUCTION AND ITS RELATED POINTS OF CONCERN. Roh, E. (Korea Electric Co., Seoul). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The long-term nuclear power plant development program in Korea is briefly summarized. The status of construction at the Ko-Ri site is described. Some of the problems associated with the construction project and the long-term program are discussed. (JWR)

22004 PWR RADIATION BUILDUP: THE COURSE AHEAD. McCormick, D. J. (Consolidated Edison of New York). Trans. Am. Nucl. Soc.; 22: 120(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22005 UPDATED MEASURE OF RADIATION DAMAGE EXPOSURE. Shure, K. (Bettis Atomic Power Lab., West Mifflin, PA). Trans. Am. Nucl. Soc.; 22: 203-204(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22006 IDENTIFICATION OF LOW-ORDER MODELS FOR A PRESSURIZED WATER REACTOR USING EXPERIMENTAL DATA. Zwingelstein, G.; Kerlin, T. W. (Univ. of Tennessee, Knoxville). Trans. Am. Nucl. Soc.; 22: 240-241(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22007 CRITICALITY CALCULATIONS ON MAINE YANKEE SPENT-FUEL RACKS CONTAINING BORAL. Denver, D. J.; Momsen B. F.; Pilat, E. E. (Yankee Atomic Electric Co., Westboro, MA). Trans. Am. Nucl. Soc.; 22: 295-296(Nov 1975).

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22008 HIGH-CAPACITY STORAGE OF NUCLEAR FUEL ASSEMBLIES. Cyboron, R. D.; Harding, R. S.; Bevilacqua, F.; (Combustion Engineering, Inc., Windsor, CT). Trans. Am. Nucl. Soc.; 22: 306(Nov 1975).

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22009 WESTINGHOUSE SPENT-FUEL STORAGE RACK CALCULATIONAL TECHNIQUES. Spier, E. M.; Hill, D. J.; Bennett, C. L. (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 306-307(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22010 DESIGN AND IMPLEMENTATION OF MAXIMUM-CAPACITY SPENT-FUEL STORAGE. Allison, M. M. (Yankee Atomic Electric Co., Westboro, MA). Trans. Am. Nucl. Soc.; 22: 307-308(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22011 MODEL FOR RAPID EVALUATION OF FUEL MANAGEMENT OPTIONS. Vogt, D. K. (Nuclear Assurance Corp., Atlanta); Carlson, R. W. Trans. Am. Nucl. Soc.; 22: 319(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22012 FUEL FAILURES AND FUEL COSTS: A PARAMETRIC STUDY. Vogt, D. K. (Nuclear Assurance Corp., Atlanta); Carlson, R. W. Trans. Am. Nucl. Soc.; 22: 319-320(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22013 OPTIMAL COASTDOWN DURATION FOR YANKEE ROWE. Watt, H. Y.; Pilat, E. E. (Yankee Atomic Electric Co., Westboro, MA). Trans. Am. Nucl. Soc.; 22: 321-322(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22014 UTILITY'S APPROACH TO IN-CORE FUEL MANAGEMENT OPTIMIZATION. Stevens, W. (Southern California Edison Co., Rosemead); Lew, B.; Shen, P. K. Trans. Am. Nucl. Soc.; 22: 324-325(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22015 FAILED TENDON INSPECTION VIA MONTE CARLO. Grzesik, J.; Okrent, D. (Univ. of California, Los Angeles). Trans. Am. Nucl. Soc.; 22: 363-364(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

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From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22017 ANALYSIS OF WATER HAMMER OBSERVED IN FEEDWATER SYSTEMS OF CERTAIN PWR SYSTEMS. Vreeland, J. A. (California State Univ., Sacramento). Trans. Am. Nucl. Soc.; 22: 540(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22018 REMOTELY CONTROLLED PLATFORM FOR INSPECTION OF STEAM GENERATOR TUBES. Marugg, M. L.; Leshem, A.; Hill, W.; Cooper, D.; Parent, E. J. (Combustion Engineering, Inc., Windsor, CT). Trans. Am. Nucl. Soc.; 22: 542-543(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22019 RECENT CONCERNS WITH REACTOR COOLANT CHEMISTRY TECHNOLOGY IN PRESSURIZED WATER REACTORS. Hicks, J. H. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 550-551(Nov 1975).
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22020 MEASUREMENT OF FUEL ELEMENT CRUD DEPOSITS IN PRESSURIZED WATER REACTORS. Solomon, Y.; Roesmer, J. (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 551-552(Nov 1975).
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22021 CHEMISTRY EXPERIENCE IN THE PRIMARY HEAT TRANSPORT CIRCUITS OF KWU PWRS. Reiss, R. (Kraftwerk Union AG, Erlangen, Ger.). Trans. Am. Nucl. Soc.; 22: 552-553(Nov 1975).
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22022 MEASUREMENT OF PWR PRIMARY COOLANT FLOW USING ^{16}N NOISE. Graham, K. F.; Gopal, R. (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 554-555(Nov 1975).
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From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22024 IDENTIFICATION OF DYNAMIC CHARACTERISTICS OF REACTOR CORE BARREL MOTION. Hsu, C.; Shu, H. T.; Kou, R. S. (New Technology, Inc., Huntsville, AL). Trans. Am. Nucl. Soc.; 22: 604-605(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22025 UTILITY CORE ANALYSIS CAPABILITY: KEY TO AVAILABILITY, FLEXIBILITY, AND RELIABILITY. White, P. J. (Florida Power and Light Co., Miami); Blake, R. A.; Brown, R. T.; Fisher, J. R.; Rothleder, B. M. Trans. Am. Nucl. Soc.; 22: 612-614(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22026 GAS TAGGING IN A PRESSURIZED WATER REACTOR. Gross, K. C.; Eckart, L. E.; Shapiro, A. (Univ. of Cincinnati). Trans. Am. Nucl. Soc.; 22: 622(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22027 FUEL ASSEMBLY FLOW-INDUCED LIFT INVESTIGATION USING GADOLINIUM IN-CORE DETECTORS. Coppola, E. J.; Mayo, C. W.; Putnam, J. M. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 625-626(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22028 POWER DISTRIBUTION MEASUREMENTS IN B AND W REACTORS. Hassan, H. A.; Paulson, A. E.; Warren, H. D. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 645(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22029 ON-LINE POWER DISTRIBUTION MONITORING WITH IN-CORE DETECTORS. Humphries, J. R.; Kadak, A. C.; Knapp, R. W. (Combustion Engineering, Inc., Windsor, CT). Trans. Am. Nucl. Soc.; 22: 647-648(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22030 MONITORING CORE AXIAL POWER DISTRIBUTION WITH MULTI-SECTION OUT-OF-CORE DETECTORS. Graham, K. F.; Easter, J. R.; Forker, J. M.; Kerr, R. A.; Gopal, R. (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 648-649(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22031 ZION STATION CORE MONITORING. Baker, J. W. (Commonwealth Edison Co., Zion, IL); Naughton, W. F. Trans. Am. Nucl. Soc.; 22: 650(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22032 THREE-DIMENSIONAL CALCULATIONAL VERIFICATION OF C-E's IN-CORE INSTRUMENTATION SYSTEM WITH LIFETIME. Terney, W. B.; Ober, T. G.; Williamson, E. A. Jr. (Combustion Engineering, Inc., Windsor, CT). Trans. Am. Nucl. Soc.; 22: 681-682(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22033 AXIAL POWER DISTRIBUTION FROM FOURIER FITTING OF FIXED IN-CORE DETECTOR POWERS. Terney, W. B.; Marks, G. H.; Williamson, E. A. Jr.; Ober, T. G. (Combustion Engineering, Inc., Windsor, CT). Trans. Am. Nucl. Soc.; 22: 682-683(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22034 IN-REACTOR EXPERIMENT TO VERIFY THE DETECTABILITY OF AXIAL FUEL GAPS. Reith, R. J.; Robertson, J. D.; Tulenko, J. S. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 683-684(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22035 DYNAMIC MEASUREMENT OF EJECTED ROD WORTH AT ZERO POWER. Putman, J. M.; Snidow, N. L.; Tulodieski, D. B. (Babcock and Wilcox, Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 668-689(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22036 REACTOR CAVITY FAST-NEUTRON STREAMING CALCULATION AND SHIELDING DESIGN BY MONTE CARLO TECHNIQUES. Yang, T. L.; Iotti, R. C. (Ebasco Services, Inc., New York). Trans. Am. Nucl. Soc.; 22: 806(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22037 QUALITY-ASSURANCE PROBLEMS AT MIDLAND NUCLEAR POWER PLANT. McGlothlan, C. K. (Oak Ridge National Lab., TN). Nucl. Saf.; 17: No. 1, 87-96(1976).
An article is presented which examines the show-cause order issued by the Director of Regulation of the Atomic Energy Commission (AEC) in 1973 and the actions taken by the AEC (now

Nuclear Regulatory Commission), the owner, the architect-engineer, and others in identifying and resolving certain quality deficiencies that have occurred since 1970 in the design and construction phases of the Midland nuclear power plant. Improvements in the Midland Quality Assurance Program, which resulted in a ruling by the AEC Regulatory Staff in favor of the owner, are discussed. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 20396, 20729, 22263, 22305, 22320, 22335, and 22336.

22038 (CONF-750117-P2, pp 1095-1130) STATUS AND POTENTIAL OF HIGH TEMPERATURE GAS-COOLED REACTORS. McCormack, R. A. (General Atomic International, San Diego, CA). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The origins of the HTGR and operational experience which demonstrates its reliability are summarized. Today's commercial HTGR's are described along with the testing and construction experience that helped assure their safety and reliability. The environmental, safety, and other advantages of the HTGR system are discussed. Extensions of present HTGR technology are also discussed. (JWR)

22039 (EIR-282) COMPARISON BETWEEN FORCED DRAFT DRY COOLING SYSTEMS AND A NATURAL DRAFT WET COOLING TOWER FOR THE HIGH TEMPERATURE GAS-COOLED REACTOR. Mayor, J. C.; Mustoe, F. J.; Leuenberger, J. M.; Jacobi, A. Jr.; Eichenberger, E. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland); Gulf General Atomic Europe, Zurich (Switzerland); Eidgenoessische Materialpruefungs- und Versuchsanstalt fuer Industrie, Bauwesen und Gewebe, Duebendorf (Switzerland)). Oct 1975. 19p. (CONF-751030-2). Dep. NTIS (US Sales Only) $4.50.

From international nuclear industries fair; Basel, Switzerland (7 Oct 1975).

Siting difficulties in Europe may lead the electricity generating utilities to adopt mechanical draft dry cooling of nuclear plants in spite of the associated economic penalty. The High Temperature Gas-cooled Reactor (HTGR), due to its high overall efficiency, is much better suited for closed loop recooling than other reactors on the nuclear market. As only little operating experience has been collected up to now with large mechanical draft dry cooling systems, a detailed technical feasibility study and an economical evaluation based on information from established manufacturers has been completed on the use of mechanical draft dry cooling systems for the HTGR. Selected results, among others a comparison with a natural draft wet cooling tower, are presented. (auth)

22040 (EUR-5395(Vol.2), pp 551-577) HIGH TEMPERATURE THERMOCOUPLES FOR CENTRE FUEL TEMPERATURE MEASUREMENT IN THE WINDSCALE AGR. Thurlbeck, A.; Bell, D. 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Four experiments have been mounted in WAGR to measure the fuel center temperature of Mk II type UO_2/SS clad fuel pins. The operational lifetimes of these experiments varied between 700 and 17,000 hours. The long lifetime and interest shown in the thermocouple performance is felt to justify the recording of high temperature thermocouple experience in a gas cooled reactor. (auth)

22041 (EUR-5395(Vol.2), pp 633-639) TEMPERATURE MEASUREMENT WITH THERMOCOUPLES AT HIGH TEMPERATURE GAS-COOLED REACTORS. Kaiser, G. E. (H.R.B., Mannheim, Ger.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Instrumentation is described for temperature measurement systems for the THTR-300 reactor and for HTGR type reactors. The systems measure temperatures at the steam generator and circulator inlets and at the outlet of the core region. (DG)

22042 (GA-A-13737) HTGR FUELS AND CORE DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending November 30, 1975. (General Atomic Co., San Diego, Calif. (USA)). 31 Dec 1975. Contract E(04-3)-167. 248p. Dep. NTIS $7.60.

The work reported includes studies of reactions between core materials and coolant impurities, basic fission product transport mechanisms, core graphite development and testing, the development and testing of recyclable fuel systems, and physics and fuel management studies. Materials studies include irradiation capsule tests of both fuel and graphite. Experimental procedures and results are discussed and the data are presented in tables, graphs, and photographs. (auth)

22043 (LA-6179-MS) BEGINNING-OF-LIFE NEUTRONIC ANALYSIS OF A 3000-MW(t) HTGR. Vigil, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1975. Contract W-7405-Eng-36. 47p. Dep. NTIS $4.00.

The results of a study of safety-related neutronic characteristics for the beginning-of-life core of a 3000-MW(t) High-Temperature Gas-Cooled Reactor are presented. Emphasis was placed on the temperature-dependent reactivity effects of fuel, moderator, control poisons, and fission products. Other neutronic characteristics studied were gross and local power distributions, neutron kinetics parameters, control rod and other material worths and worth distributions, and the reactivity worth of a selected hypothetical perturbation in the core configuration. The study was performed for the most part using discrete-ordinates transport theory codes and neutron cross sections that were interpolated from a four-parameter nine-group library supplied by the HTGR vendor. A few comparison calculations were also performed using nine-group data generated with an independent cross-section processing code system. Results from the study generally agree well with results reported by the HTGR vendor. (auth)

22044 (ORNL/TM-5206) INELASTIC ANALYSIS OF TWO PLATES UNDER DEFORMATION DEPENDENT LOADS. Iskander, S. K.; Collins, C. W.; Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 24p. Dep. NTIS $5.00.

Cover plates are used in current designs for high temperature gas-cooled reactors to compress the mineral fiber insulation against the inside of the liner of the prestressed concrete pressure vessel. In the upper plenum, these plates are hexagonal and specified as carbon steel; in the lower cross ducts, the plates are square and made of Hastelloy X. The General Atomic Company has specified both damage and safety limit criteria for these plates. These plates have been analyzed at these limits using the inelastic finite element computer program EPACA. The results indicate that the total strains for the square plate were within the specified values; however, the maximum deformations at the free corners indicate separation from the insulation and failure to achieve one of the design requirements. Since no material data were available for carbon steel at the limiting temperatures, it was assumed that the hexagonal plates were constructed of 2¼ percent Cr-1 percent Mo material. Although this material was found to produce satisfactory performance, extrapolation of available information would lead to the conclusion that the performance of carbon steel plates would not be satisfactory at the specified conditions. (auth)

22045 (RD/B/N-3482) IN SITU MEASUREMENT OF THREAD STRAIN IN MILD STEEL BOLTS. Haines, N. F.; McIntyre, P. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1975. 20p. Dep. NTIS (US Sales Only) $3.50.

A technique has been developed for making remote measurements of thread strain in mild steel bolts. Experience gained with an instrument designed to make measurements on ¾ in. BSF bolts in a Magnox reactor has demonstrated that an extension of 0.03 mms may be observed on an individual thread. Although the instrument developed was designed for a particular application the overall size and weight could be considerably reduced, particularly for a hand operated device. (auth)

22046 SHORT-COURSE ON HIGH-TEMPERATURE GAS-COOLED REACTORS. Kasten, P. R. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 89(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22047 DEVELOPMENT OF A RECYCLE FUEL FOR THE HTGR. Homan, F. J.; Long, E. L. Jr.; Beatty, R. L. (Oak

Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 193-194(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22048 IMPROVED COATING PROCESS FOR HIGH-TEMPERATURE GAS-COOLED REACTOR FUEL. Lackey, W. J.; Sease, J. D.; Costanzo, D. A.; LaValle, D. E. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 194-195(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22049 SUBCRITICAL MEASUREMENTS WITH IRRADIATED AND UNIRRADIATED URANIUM METAL FUEL ELEMENTS. Toffer, H.; Nielsen, L. A. (United Nuclear Industries, Inc., Richland, WA). Trans. Am. Nucl. Soc.; 22: 292-295(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22050 COMPARATIVE STUDY OF THE EFFECT OF URANIUM 236 IN THE FUEL UTILIZATION FOR THE HTGR AND PWR. Marzo, M. A. S.; Hukai, R. Y. (Instituto de Energia Atomica, Sao Paulo, Brazil). Trans. Am. Nucl. Soc.; 22: 326-327(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22051 CHEMICAL REPROCESSING OF HTGR FUELS. Roeh, A. P.; Wheeler, B. R. (Allied Chemical Corp., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 336(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22052 REFABRICATION TECHNOLOGY FOR HTGR FUELS. Sease, J. D. (Oak Ridge National Lab, TN); Zimmer, E.; Bradley, R. A. Trans. Am. Nucl. Soc.; 22: 336-337(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22053 WASTE MANAGEMENT CONSIDERATIONS IN HTGR RECYCLE OPERATIONS. Pence, D. T.; Shefcik, J. J.; Heath, C. A. (General Atomic, San Diego, CA). Trans. Am. Nucl. Soc.; 22: 337-338(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22054 QUALITY ASSURANCE AND THE NUCLEAR STEAM SYSTEM SUPPLIER. Jackson, J. P. (General Atomic, San Diego, CA). Trans. Am. Nucl. Soc.; 22: 528-529(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22055 SIMULATION OF THE BEHAVIOR OF A BRAYTON-CYCLE HTGR-POWERED THERMAL UTILITY SYSTEM FOR TOTAL ENERGY APPLICATIONS. Stetkar, J. W.; Golay, M. W. (Massachusetts Inst. of Tech., Cambridge). Trans. Am. Nucl. Soc.; 22: 601-602(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22056 RADIATION TRANSPORT, GAS WASTE MANAGEMENT, AND CONTAINMENT ACCESSIBILITY IN HTGRs. Kang, C. S.; Weingart, M. D. (United Engineers and Constructors, Inc., Philadelphia). Trans. Am. Nucl. Soc.; 22: 642-643(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22057 HIGH-CONVERSION HTGR FOR RESOURCE CONSERVATION. Brogli, R. H.; Hays, M. L.; Lane, R. K.; Turner, R. F. (General Atomic, San Diego, CA). Trans. Am. Nucl. Soc.; 22: 707-708(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22058 SOME OPTICAL DEVICES FOR INSPECTION WITHIN GRAPHITE MODERATED REACTORS. Pulfer, R. F. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).
From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.
A number of tools for the optical inspection of graphite moderated reactors are described. A 51 mm diameter zoom television camera with attachments can be used for the following: tube inspection; multidirectional illuminating and viewing; and illuminating and viewing transversely at distances up to 8 m. Single and twin zoom television cameras for multidirectional imaging of the above-core reactor internals are designed to view to the side of obstructing standpipe assemblies. A photographic camera of 60 mm format is also described for viewing above-core reactor internals by one of a number of lenses and assisted by a television reflex viewfinder and focusing aid. (auth)

22059 LASER CORROSION MONITOR. Richards, P. H.; Tozer, B. A. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).
From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.
The technique of oxide thickness measurement by the laser "punch and probe" method is described, the accuracy of the method and possible errors are discussed, and its range of applications indicated. Considerable reactor experience has now been accumulated with this instrument. The lessons learned are discussed, with particular reference to possible future developments. (auth)

22060 RECENT DEVELOPMENTS IN THE MEASUREMENT OF OXIDE LAYERS AND THEIR EFFECT ON COMPONENT INTEGRITY. Haines, N. P. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).
From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.
Ultrasonic crack detection methods provide the most direct information on the integrity of bolted assemblies in Magnox reactors. However, where access is either impossible or difficult other measurements may be made more conveniently. Measurements of oxide thicknesses and silicon contents of nearby, more easily accessible components may be used to provide assessment data. Alternatively, the measurement of strain incurred in a small number of bolts may be made more quickly than crack detection measurements in a statistically significant sample. A new ultrasonic system capable of measuring both free surface and interface oxide thicknesses is described. The small size and low weight (4Kg) make the instrument simple and quick to handle with a light duty manipulator. An account is also given of an instrument being developed for measuring accumulated strains in bolts. (auth)

22061 INSPECTION OF MAGNOX REACTORS. Gow, R. S.; Hurrell, R. J. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).
From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.
The Generating Board's Magnox Reactors are shut down for biennial inspection. Photography and television are used to obtain records of the state of the plant. Some critical components subject to risk of cracking are subject to ultrasonic inspection. Considerable development of remote handling tools has taken place. Material sampling by remote means has been carried out. The state of the reactors is thereby investigated, which, together with an extrapolation of the operational pattern, allows an assessment to be made that operation may safely continue for a further period. (auth)

22062 INTERNAL EXAMINATION OF CAGR'S. Walton, P. J.; Langley, J. P.; Simons, C. R.; Hart, J. D. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).
From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.
During selected reactor maintenance periods it will be necessary to conduct examinations of reactor internal components to gain assurance of their continuing integrity throughout the design life. Equipment for remote examination is being developed that will measure the distortions of the graphite moderator bricks and extract samples from them for analysis. Other remotely operated equipment will allow closed circuit TV viewing inside the reactors: the equipment provides both wide field and detailed inspection facilities within a single compact unit. Manipulators are being developed to bring the viewing units to the best vantage points. Reeling and handling gear will be operated from outside the vessels and these provide full containment at all times. (auth)

22063 STEAM TURBINE DRIVEN CIRCULATORS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. I. Design. Yampolsky, J.; Cavallaro, L.; Thurston, G. C.; Nichols, M. K. (Gulf General Atomic Co., San Diego, CA). J. Eng. Power; 96: No. 2, 95-101(Apr 1974).
The high-temperature gas-cooled reactor is characterized by integration of the primary coolant circuit and components within a Prestressed Concrete Pressure Vessel. This concept requires particular features and assurance in the circulators that are used to circulate the primary coolant fluid. Each circulator employs a single-stage axial compressor driven by a single-stage turbine

which is in series with the main steam turbogenerator. The circulator is lubricated by water and is capable of variable speed operation. An extensive design and development program was carried out to provide a family of circulators for a range of reactor sizes. (Electr. Electron Abst.)

22064 CASE FOR A SIMPLIFIED AGR. Farkasch, G. J. Inst. Nucl. Eng.; 16: No. 5, 141-142, 147(Sep 1975).

Some of the difficulties arising with the existing Advanced Gas Cooled Reactor system are discussed. It is stated that the system is difficult and expensive to construct, presents problems in a number of fields, including gas dynamics and acoustic vibration, and is unnecessarily complex. It is also inflexible and may prove uneconomic in operation. Endeavors to meet the design specification have led to serious delays and heavy expense in the design and construction stages, and the operational success remains to be demonstrated. It is suggested that it may now be profitable to consider some basic simplifications of the system, including some downrating and the introduction of some flexibility into the reactor/turbine arrangements. A short history is included of the nuclear power industry in this country, with emphasis on the success of the Magnox reactors. Following several successful years of operation of the Magnox stations it was decided to examine the possibility of increasing steam temperatures and pressures, leading to the design and construction of the AGR system. The problems associated with this system are briefly reviewed together with benefits arising from general nuclear power station experience. Ideas for simplification are suggested. (UK)

22065 BRITAIN'S NUCLEAR WORKHORSES. Hawkins, A. E. (Central Electricity Generating Board, London). J. Br. Nucl. Energy Soc.; 14: No. 4, 293-294(Oct 1975).

From European nuclear conference; Paris, France (21 Apr 1975). See CONF-750411-.

Britain's record in the field of nuclear power is briefly summarized. The success of the Magnox reactors is attributed to their reliability, good safety record, and the competitiveness of the fuel costs. The AGR stations are expected to prove extremely valuable in spite of initial setbacks. In planning for future plants, it is suggested that the best way of utilizing the financial, human, and material resources required is by international collaboration on design and development. (UK)

22066 GAS COOLED REACTOR OPERATING EXPERIENCE. Prior, W. J. (Central Electricity Generating Board, London); Hutiger, J.; Insch, G. M. J. Br. Nucl. Energy Soc.; 14: No. 4, 287-292(Oct 1975).

From European nuclear conference; Paris, France (21 Apr 1975). See CONF-750411-.

The development of utilization of graphite moderated, natural uranium reactors in France and the UK is reviewed, and the results of over a decade of commercial operation by the electrical utilities are summarized. Although very limited benefit was obtained from plant replication, since the policy in both countries was to seek reduction in electrical generation costs by design evolvement, nevertheless, high lifetime availability was obtained with particularly good reliability at winter peak periods. Operation and maintenance of the plants resulted in significantly low levels of radiation and contamination with very low radiological discharge levels to the environment. A major advance in reactor safety was achieved with the adoption of a concrete pressure vessel for the later reactors. Development of special equipment facilitated far more extensive remote inspection, repair, and replacement operations that were considered feasible in the early design stages. The good performance of the plant with respect to radiological discharges, the low dose to the staff, and the policy of full co-operation with the local authorities fostered acceptance of the plant by the general public. In France, the construction of this type of reactor terminated in 1969, but the UK developed the advanced gas cooled reactor, using enriched uranium oxide fuel clad in stainless steel to produce steam conditions comparable to those in a modern fossil-fuel plant. The experience resulting from the design, construction, and operation of this now mature program of gas cooled reactors is being utilized in the development of the high temperature gas cooled reactor for future commercial exploitation. (auth)

22067 PROCESS FOR PRODUCTION OF FUEL BODIES, FUEL ELEMENTS, AND ABSORBER ELEMENTS FOR HIGH TEMPERATURE REACTORS. Rachor, L.; Spener, G. (to Hochtemperaturreaktor-Brennelement GmbH). US Patent 3,912,798. 14 Oct 1974. Priority Date 20 Sep 1972, German, Federal Republic of (F. R. Germany). 6p.

Fuel bodies, fuel elements and absorber elements for high temperature reactors are produced by isostatic pressing of a mixture of binder containing a graphite powder and encased coated fuel particles and/or absorber particles at high compression ratios wherein the pressing process is carried out in a plurality of pressing steps with stepwise increasing compression so that in each pressing step a fixed compression takes place which is so selected that there is not required a specific vacuum step or deaeration step in the powdery condition and the air compressed in the pressing process can escape from the porous pressed article without injuring the structure and that a higher pressure is employed from pressing step to pressing step until the final compression and that in a first pressing step there is preformed in a rubber mold with a suitable cavity at low pressure kernels of the pressed article from a homogeneous mixture of encased, coated fuel particles and/or absorber particles and binder containing graphite molding powder and this preformed kernels embedded in a coating of binder containing graphite molding powder in a second pressing step in a second rubber mold with a suitable cavity are prepressed at low pressure, and in a third pressing step this preformed article is finally pressed at high pressure in a further rubber mold having a suitable cavity. (Official Gazette)

22068 NUCLEAR REACTOR. Tilliette, Z. (to Commissariat a l'Energie Atomique). US Patent 3,909,351. 30 Sep 1975. Priority Date 2 May 1973, France. 10p.

A description is given of a nuclear reactor and especially a high-temperature reactor in which provision is made within a pressure vessel for a main cavity containing the reactor core and a series of vertical cylindrical pods arranged in spaced relation around the main cavity and each adapted to communicate with the cavity through two collector ducts or headers for the primary fluid which flows downwards through the reactor core. Each pod contains two superposed steam-generator and circulator sets disposed in substantially symmetrical relation on each side of the hot primary-fluid header which conveys the primary fluid from the reactor cavity to the pod, the circulators of both sets being mounted respectively at the bottom and top ends of the pod. (Official Gazette)

22069 COMPUTER SIMULATION OF PULSED-NEUTRON EXPERIMENTS PERFORMED ON THE FORT ST. VRAIN HIGH-TEMPERATURE GAS-COOLED REACTOR. Pfeiffer, W. (General Atomic, San Diego, CA). Nucl. Technol.; 27: No. 3, 337-351 (Nov 1975).

Computer simulations were used to determine the optimum source location, detector location, and pulse rate prior to performing pulsed-neutron experiments on the 330-MW Fort St. Vrain high-temperature gas-cooled reactor (HTGR). The simulation procedure involved calculation of the amplitudes, decay constants, and modal shapes of the first few kinetic modes in the general expansion of the time response of the neutron flux following each pulse. The kinetic modes were calculated by the eigenfunction expansion method in two-dimensional geometry assuming two energy groups and six delayed-neutron precursors. The major limitation in the calculation is the use of two-dimensional core models, i.e., the assumption of separation of variables. For most power reactors on which pulsed-neutron experiments might be performed, this limitation should not be serious. (auth)

22070 ANALYSIS AND RESULTS OF PULSED-NEUTRON EXPERIMENTS PERFORMED ON THE FORT ST. VRAIN HIGH-TEMPERATURE GAS-COOLED REACTOR. Pfeiffer, W.; Brown, J. R.; Marshall, A. C. (General Atomic, San Diego, CA). Nucl. Technol.; 27: No. 3, 352-375(Nov 1975).

Pulsed-neutron experiments were performed on the Fort St. Vrain reactor to determine the reactivity of the core for various control rod configurations while the reactor was still subcritical. For all configurations the reactivity was inferred from the inhour equation using the measured decay constant and a calculated generation time. For the configurations near critical, both the reactivity and generation time were determined using the extrapolated area-ratio method. The predicted reactivities agreed poorly with those inferred from the experiments. However, by adding 5 ppM of boron to the reflector calculational model, the calculated generation time was significantly reduced. This brought the inferred reactivity into good agreement with that calculated for all control rod configurations. This emphasizes the dependence of the interpretation of pulsed-neutron experiments on calculations and the importance of the reflector in a large HTGR. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 22314 and 22349.

22071 (AAEC/E-339) MEASUREMENT OF A MODIFIED RELATIVE CONVERSION RATIO IN MULTI-ROD CLUSTERS.

Duerden, P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1975. 50p. Dep. NTIS (US Sales Only) $4.00.

An Indo-Australian experiment is described in which relative conversion ratios for a range of UO_2 rod cluster fuel elements in a heavy water moderated reactor were measured using a high resolution Ge(Li) detector to measure directly the neptunium activity following neutron capture in ^{238}U. The results are compared with calculations made with the UKAEA lattice code WIMS. (auth)

22072 (CONF-750117-P2, pp 791-821) HEAVY WATER POWER REACTOR. Lewis, W. B. (Queen's Univ., Kingston, Canada). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

It is shown that the thorium fuel cycle in CANDU reactors challenges breeders and fusion as the simplest means of meeting the world's large scale demands for energy for centuries. Thorium oxide fuel allows high power density with excellent neutron economy, confirmed by detailed reactor physics calculations with the LATREP computer program. The combination of thorium fuel with organic caloporteur promises easy maintenance and thereby very high availability of the whole plant that more than offsets a slightly higher fueling cost. The fueling cost is still low but not as low as is possible with other CANDU heavy-water moderated reactors. (auth)

22073 (CONF-750117-P2, pp 823-882) PRELIMINARY DESIGN STUDY OF A 600 MW(e) HEAVY-WATER-MODERATED ORGANIC-COOLED REACTOR POWER PLANT. Chien, J. P. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The reactor is moderated by heavy water, cooled by organic liquid and fueled with natural uranium metal. The core is a calandria type with pressure tubes forming the coolant channels and housing the fuel assemblies. There is a hexagonal partition which divides the core into two nearly equal zones. The inner zone can be added with boric acid into the moderator for shim control and flux flattening. Ozhennite-0.5 is selected for both cladding and pressure-tube material. HB-40 is used as the reactor coolant. Annual shutdown refueling is adopted. An average burnup of 6000 MWD/MTu can be attained through refueling management. Reactor design data and calculation results are presented. Also, preliminary conceptual designs for systems of primary coolant, moderator, steam-turbine, instrumentation, and control are presented. (auth)

22074 (CONF-750117-P2, pp 883-906) ECONOMIC ANALYSIS ON A CONCEPTUAL 600 MW(e) HEAVY-WATER-MODERATED ORGANIC-COOLED REACTOR POWER PLANT. Ho, S. L. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

This paper first estimates the capital costs of typical HWOCR and LWR power plants. The power generation costs of a 600 MW(e) HWOCR and BWR are then calculated. The obtained power cost of HWOCR power plant is 15.230 mills/kwh, while that of a BWR power plant is 15.537 mills/kwh. Since the natural uranium cycle is immune to changes and uncertainties in the cost of enrichment service, the HWOCR appears to be most promising as a future nuclear power plant concept. (auth)

22075 (CONF-750117-P2, pp 957-969) DEVELOPMENT PROGRAM OF NEW TYPES OF POWER REACTOR: FAST BREEDER AND HEAVY WATER REACTOR. Oyama, A. (Japan Atomic Industrial Forum, Tokyo). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The Japanese program for development of LMFBR's and heavy-water-moderated light-water-cooled reactors is reviewed. (JWR)

22076 (EUR-5395(Vol.2), pp 497-507) HBWR EXPERIENCE WITH IN-CORE MEASUREMENT OF CENTRE FUEL TEMPERATURES WITH THERMOCOUPLES. Aarset, B.; Kolstad, E. (OECD Halden Reactor Project, Norway). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

At the Halden Project refractory metal thermocouples have been used to measure center fuel temperatures in the Halden Boiling Heavy Water Reactor. Thermocouple types and mounting techniques are described, and experience with in-core application of some 150 such thermocouples at temperatures up to about 2500°C is discussed. (auth)

22077 CANDU FUEL-POWER RAMP PERFORMANCE CRITERIA. Penn, W. J. (Canadian General Electric Co., Peterborough, Ont.); Lo, R. K.; Wood, J. C. Trans. Am. Nucl. Soc.; 22: 209-210(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22078 THORIUM CYCLE IN HEAVY-WATER-MODERATED PRESSURE TUBE (CANDU) REACTORS. Hatcher, S. R.; Banerjee, S.; Lane, A. D.; Tamm, H.; Veeder, J. I. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Am. Nucl. Soc.; 22: 334-336(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22079 PROSPECTS FOR SELF-SUFFICIENT EQUILIBRIUM THORIUM CYCLES IN CANDU REACTORS. Critoph, E.; Banerjee, S.; Barclay, F. W.; Hamel, D.; Milgram, M. S.; Veeder, J. I. (Atomic Energy of Canada Limited, Chalk River, Ont.). Trans. Am. Nucl. Soc.; 22: 706-707(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22080 DEVELOPMENT OF ULTRASONIC FLAW DETECTIVE DEVICE OF PRESSURE TUBES FOR THE PROTOTYPE ADVANCED THERMAL REACTOR "FUGEN." Shibato, E.; Kato, R.; Kino, H. Hitachi Hyoron; 56: No. 6, 13-16(Jun 1974). (In Japanese)

Inservice Inspection (I.S.I.) for pressure tubes in the core of the prototype advanced thermal reactor is to be carried out under the program listed for its characteristic structures and materials. The major items of I.S.I.: (1) Volumetric inspection by ultrasonic flaw detector. (2) Visual inspection by bore-scope and I.T.V. systems. (3) Measurement of inside-diameter and curvature of pressure tube. Apparatuses for I.S.I. which are mostly under development include the following: A subsize remote-controlled ultrasonic flaw detective device which proved its high performance in the test. (Electr. Electron Abstr.)

22081 IN-SERVICE INSPECTION AND MONITORING OF THE WINFRITH STEAM GENERATING HEAVY WATER REACTOR. Watkins, B. (United Kingdom Atomic Energy Authority Research Group, Risley, Eng.); Negus, B.; Perry, A. pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.

The surveillance and inspection techniques being used on the Winfrith Steam Generating Heavy Water Reactor are described. The results obtained to date are discussed. No significant defects have been observed after 7 years operation. The effects of irradiation on chemical and mechanical behavior are less than was anticipated during the design stage, but attention is drawn to the difficulties associated with restriction on personnel access due to deposition of radioactive crud. (auth)

22082 STEAM GENERATING HEAVY WATER REACTOR. I. The SGHWR Concept. Middleton, J. E. (Inst. of Nuclear Engineers, London). J. Inst. Nucl. Eng.; 16: No. 5, 131-140(Sep 1975).

An account is given of the SGHWR, the prototype of which was built by the United Kingdom Atomic Energy Authority at Winfrith, under the following headings: Introduction; origin of the SGHWR concept; conceptual design (choice of reactor type, steam cycle, reactor coolant system, nuclear behavior, fuel design, core design, and protective, auxiliary, and containment systems); operation and control (integrity of core cooling, reactivity control, power trimming, long term reactivity control, xenon override, load following, power shaping, spatial stability control, void coefficient); protective systems (breached coolant circuit trip, intact coolant circuits trip, power set-back trip); dynamic characteristics; reactor control; station control (decoupled control system, coupled control system, rate of response); Winfrith prototype (design and safety philosophy, conceptual features and parameters, reactor coolant system, protective systems, emergency core cooling, core structure, fuel design, vented containment). (UK)

22083 PICKERING GENERATING STATION. Morison, W. G. (Ontario Hydro Research Lab., Toronto). J. Br. Nucl. Energy Soc.; 14: No. 4, 319-326(Oct 1975).

From Joint Institution of Mechanical Engineers and British Nuclear Energy Society meeting; London, United Kingdom of Great Britain and Northern Ireland (UK) (14 Jun 1975). See CONF-7506110-1.

The design, operation, and economics of the Pickering generating station are described. Pickering A comprises four 508 MW(e) units and is based on the Candu system of heavy water moderated, pressurized heavy water cooled, uranium dioxide fueled, horizontal pressure tube reactor. Brief details are given of station layout and principle design parameters. Safety features are described and a brief account is given of scheduling, construction, and commissioning Operating performance is discussed. Turbine generators and auxiliaries and the feedwater system contributed to more than half the outage time. An illustration is given of incorrect rolling operation which caused cracks in the Zr-Nb pressure tube, resulting in several leaks in Unit 3. Heavy water losses were low, as were radioactive releases. Economic features are discussed in terms of capital cost, operating costs, and total unit energy cost. Reference is made to Pickering B which is a 4 × 540 MW(e) station, a mirror image of Pickering A, and scheduled for operation in 1980. The interest in the Pickering station being shown in many areas of the world is attributed to its simplicity, low fuel cycle cost, versatile pressure tube design features which meet requirements for safety, reliability, and maintainability. (UK)

22084 SGHWR OPERATIONS EXPERIENCE. Cartwright, H. (United Kingdom Atomic Energy Authority Reactor Group, Winfrith, Eng.). J. Br. Nucl. Energy Soc.; 14: No. 4, 295-296(Oct 1975).

From European nuclear conference; Paris, France (21 Apr 1975). See CONF-750411-.

A very brief synopsis is given of seven years operating experience with the SGHWR reactor at Winfrith Heath, which highlights a number of features showing that the reactor can perform in ways which are important to future commerical plants. The importance of vigilance in the detailed design to avoid health physics problems is stressed. (UK)

Power Reactors, Breeding

Refer also to abstracts 19793, 20427, 21548, 22075, 22316, 22321–22324, 22334, 22355–22359, 22361–22399, 22401–22405, 22408–22426, 22438, 22441, 22446–22448, 22462, 22468, 22481, 22482, 22601, and 22608.

22085 (ANL-8010, pp 19-330) FAST REACTOR PHYSICS. 1972.

In Applied Physics Division annual report, July 1, 1971–June 30, 1972. (Argonne National Lab., Ill. (USA)).

Information is presented concerning reactor kinetics, lattice parameters, reactivity worths, and reaction rates in zero power reactor mockups for LMFBR development. (DCC)

22086 (ANL-CT-76-21) ACOUSTIC DETECTION OF THE COLLAPSE OF A SODIUM VAPOR BUBBLE IN AN INFINITE SEA OF SODIUM. Carey, W. M. (Argonne National Lab., Ill. (USA)). Dec 1975. 50p. Dep. NTIS $4.00.

A discussion of the problem of sodium vapor bubble collapse is presented. The physics of vapor collapse is presented in light of the work by Peppler et al. Theoretical estimates of the sound source level based on the work by Rayleigh and Judd are compared to an approximate pressure-volume work approach and recent experimental observations. Reactor ambient noise and transmission loss considerations are presented in regard to their impact on this detection problem. A methodology is proposed which considers the importance of the sound source level, ambient noise, transmission loss and a detection threshold and provides a means by which the feasibility of sodium vapor bubble collapse detection in an operating LMFBR may be assessed. The interrelationships between the detection threshold and the probability of detection and false alarm are discussed and applied to a standard acoustic square law detection system. This analysis clearly illustrates that the feasibility of such a detection system is strongly dependent on the knowledge of sound source levels, ambient noise levels and the transmission loss between the source and receiver. Furthermore, requirements of a high degree of probability of detection and a low probability of false alarm were found to require a high signal to noise ratio for a single sensor system but that the probability of false alarm requirement could be relaxed for systems multiple independent sensors. Finally, the need for additional experimental and theoretical information is presented in terms of sound source levels, ambient noise and a means for determining transmission loss. (auth)

22087 (ANL-Trans-1036) CORE AND SUBASSEMBLY DESIGN AND DEVELOPMENT PROGRAM OF A 1200 MWe FAST BREEDER REACTOR. Clauzon, P.; Estavoyer, M.; Leclere, J.; Marmonier, P.; Mougniot, J. C.; Pontier, M.; Skok, J. Translated from Bull. Inf. Sci. Tech. (Paris); No. 182, 13-22(1973). 19p. Dep. NTIS $3.50.

The problems encountered during the study of the core of a 1200 MW(e) fast power plant are presented. The test and development programs are described. A description of the core and the design of the main subassemblies are given. (FR)

22088 (CONF-750117-P2, pp 1131-1172) LIQUID METAL FAST BREEDER REACTOR: THE ANSWER TO U.S. INDUSTRIAL SURVIVAL. Baron, S. (Burns and Roe, Inc., Oradell, NJ). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The LMFBR is compared with other potential energy sources for meeting the projected U.S. energy needs while protecting the environment. It is suggested that the LMFBR in combination with existing power plant technology is the only way of meeting these needs. (JWR)

22089 (CONF-750117-P2, pp 1173-1189) U.S. LIQUID METAL FAST BREEDER REACTOR PROGRAM. Nemzek, T. A. 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The reasons for having the LMFBR program are briefly discussed. The objectives of the program are discussed and the various subtasks involved in meeting the objectives are reviewed. Fuels and materials development, safety research, and components development are described. (JWR)

22090 (EUR-5395(Vol.1), pp 413-428) ENVIRONMENTAL AND LONG-TIME TESTS ON THERMOCOUPLES FOR MEASURING THE FUEL-OUTPUT-TEMPERATURE IN THE SNR 300. Hans, R.; Knaak, J. (INTERATOM, Bensberg, Ger.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Chromel/Alumel thermocouples sheathed with 304L stainless steel and insulated with MgO are integrated to fuel element probes to indicate sodium temperature at the outlets of the fuel channels of the SNR 300. Tests on incorporated thermocouples are reported in this paper. After more than 5000 hours of long term testing at 680 K mean temperature none of 196 thermocouples failed. (auth)

22091 (GEAP-13825-15) INSTRUMENTATION DEVELOPMENT. Fifteenth Quarterly Report, July–September 1975. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Oct 1975. Contract E(04-3)-893. 17p. AT.

Progress is summarized in the areas of high temperature neutron monitoring instrumentation and advanced signal transmission methods. (DG)

22092 (HEDL-TME-75-69) ENGINEERING TECHNOLOGY AND DEVELOPMENT TECHNICAL PROGRESS REPORT, APRIL-JUNE 1975. Noordhoff, B. H.; Weber, S. A.; Trego, A. L.; Yatabe, J. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1975. Contract AT(45-1)-2170. 96p. AT.

Progress is summarized in the areas of FFTF and LMFBR test program engineering, control and data systems, reactor instrument development, and neutron radiography. (DG)

22093 (WAPD-TM-1060) PLASTIC ANISOTROPY OF POLYCRYSTALLINE ZIRCALOY (LWBR DEVELOPMENT PROGRAM). Daniel, R. C. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Feb 1976. Contract E(36-1)-GEN-14. 61p. Dep. NTIS $4.50.

A model is presented to describe the deformation of polycrystalline Zircaloy for principal stress systems coincident with the principal axes of anisotropy. Applicable to many materials which undergo prism slip and twinning, the model employs X-ray diffraction data quantitatively to specify the influence of crystallographic texture. Uniaxial test data are used to evaluate the slip stress and pole (twinning) stress as functions of strain. Contractile

strain ratios and 0.2 percent offset yield stresses calculated for uniaxial tests of Zircaloy at room temperature are in satisfactory agreement with experimental values for greatly differing textures. Observed differences between tensile and compressive flow stresses are adequately represented. Strain-induced texture changes caused by twinning do not significantly affect contractile strain ratios for longitudinal (rolling or drawing direction) strains in Zircaloy fabricated by usual methods. However, the model predicts significant changes in anisotropic properties after uniaxial tensile strains parallel to directions which have high basal pole densities. The model provides improved insight into the physical significance of anisotropy parameters in continuum plasticity theory. (auth)

22094 (WARD-SG-3045-1(Vol.1)) ALTERNATE STEAM GENERATOR DEVELOPMENT PROGRAM. Phase I Summary Report, September 1974–December 1974. Volume 1. Development of Alternate Steam Generators for LMFBR Plants. Adkins, C. R.; Mangus, J. D.; Gross, M. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Oct 1975. Contract E(11-1)-3045. 218p. AT.

The overall purpose of the program described is the development of a steam generator and associated systems which possess the reliability to be used directly in the primary sodium system of an LMFBR. The program schedule has been established to provide a full-size steam generator model for testing in, or as a back-up for, the secondary steam generation system in the CRBR plant. The purpose of Phase I of the program has been to explore the capabilities and limitations of potential, alternate steam generators. The specific concepts that have been covered in this phase are: (a) general fluidized bed concepts, i.e., gaseous heat transfer media with solid suspensions, (b) static bed concepts, using a solid heat transfer medium, (c) alternate intermediary heat transfer fluids. A status report on items (a) and (b) is included. (auth)

22095 DESIGN OF ULTRASONIC VIEWING SYSTEMS FOR CFR OPERATION. McKnight, J. A. (United Kingdom Atomic Energy Authority Research Group, Risley, Eng.); Fothergill, J. R.; Barnes, S. pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240–.

The application of ultrasonic under-sodium viewing techniques to a Commercial Fast Reactor enables certain operational requirements to be satisfied. Major instruments in this category are the sweep-arms and fuel sub-assembly identifiers. A study of the techniques available for using ultrasound in the high temperature sodium environment has shown that these applications are best designed to rely on waveguides. These enable conventional high efficiency transducers to be used. Two kinds of waveguide, the liquid filled tube and the solid steel variants, are considered as practical techniques. Extensions of the performance of these two instruments to give images of the reactor interior are seen as feasible developments. Image science techniques will be needed to maximize the information finally displayed. (auth)

22096 UNDER SODIUM VIEWING: DEVELOPMENTS AT MARCHWOOD ENGINEERING LABORATORIES. Hepworth, J. K.; Wright, D. G.; Little, M. J. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240–.

An outline is presented of work being carried out at Marchwood Engineering Laboratories into the principles and problems involved with ultrasonic systems for examining components under sodium. The system being considered is one in which the ultrasonic beam is scanned electronically over the objects being examined and the reflected signals are processed digitally in order to produce a visual image. It is not clear at the present time whether waveguides or high temperature transducers offer the best prospects for operation in a reactor environment, but at Marchwood several types of waveguide are being investigated. It should be possible to develop an ultrasonic device which has a range of a meter or more and gives a resolution of a few millimeters. Such a system could be used above the core instead of a sweep arm to inspect the top of the core and to penetrate regions of the core through vacant sub-assembly positions. Provided that access is available, such an ultrasonic system could also be used in other parts of the reactor to inspect thermal insulation, the heat exchanger, pipework and to check for structural integrity and deformation. (auth)

22097 COMMERCIAL EXPLOITATION OF FAST REACTORS IN THE UK. Moore, R. V. (United Kingdom Atomic Energy Authority Reactor Group, Risley, Eng.). J. Br. Nucl. Energy Soc.; 14: No. 4, 297-298(Oct 1975).

From European nuclear conference; Paris, France (21 Apr 1975). See CONF-750411-.

The first commercial fast reactor in the United Kingdom will be a 1320 MW gross single reactor station, planned for full power operation in 1984. A very brief account is given of the U.K.A.E.A. policy in preparing for commerical exploitation of fast reactors. This involves the design and construction of full scale plants for fuel processing and refuelling and associated fuel cycle activities. (UK)

22098 NUCLEAR REACTOR FUEL ELEMENTS. Hart, D. F. (to United Kingdom Atomic Energy Authority). British Patent 1,401,308/B/. 30 Jul 1975. Filed date 12 Sep 1972. 3p.

It is stated that one type of fuel element assembly used in a sodium cooled fast reactor comprises a hexagonal bundle of slender fuel elements enclosed by a casing, termed a wrapper. The fuel elements are each helically wrapped with wire to brace them apart and prevent bowing and vibration and to ensure efficient cooling. The width of the gap between the fuel bundles and the wrapper is mainly governed by the height of the wire wraps of the outer fuel elements, and the edge channels resulting from the wire wraps of the same size tend to cause overcooling of the outer elements. In the arrangement described at least one collapsible filler is located within the gap, the filler being longitudinally convoluted to follow the transverse contour of the bundle. This substantially eliminates vibration of the bundle and restricts the cross-sectional area of the gap. The filler can collapse during irradiation to accommodate differential irradiation growth of bundle and "wrapper". A preferred construction of collapsible filler comprises two spaced membranes forming a longitudinally convoluted envelope, one membrane being slit and deformed to provide leaf springs that react on the wrapper. (UK)

22099 NUCLEAR REACTOR FUEL ELEMENT ASSEMBLIES. Linning, D. L.; McAreavey, G. (to United Kingdom Atomic Energy Authority). British Patent 1,402,936/B/. 13 Aug 1975. Filed date 14 Dec 1971. 4p.

Reference is made to fuel element assemblies of the type comprising a bundle of spaced fuel pins enclosed in a casing, referred to as a wrapper, through which liquid coolant can flow. Such assemblies may be used in a fast breeder reactor, where they are clustered in close parallel array upstanding from a diagrid. The improved assembly described comprises a bundle of fuel pins, with wire wrap spacing means, enclosed in a wrapper through which liquid coolant can be passed. The wrapper has a flexible lining that in conjunction with the wrapper defines an interspace to contain pressurized gas; the lining is inwardly flexible by pressurized gas to embrace the bundle of fuel pins. In use the lining is pressurized against the bundle of fuel pins, thereby bracing the pins against bowing and vibration. The coolant flow through the bundle remains substantially constant since the lining can expand to accommodate fuel pin swelling. The jacket of gas also provides a thermal barrier to reduce heat transfer from the fuel pins to the wrapper and the wrapper is thus maintained at the relatively lower temperature of the liquid coolant flowing between the fuel element assemblies, which for a sodium cooled fast reactor can be about 400°C. Neutron induced voidage below 400°C is found to be considerably less in some materials suitable for wrappers than at higher temperatures, so that bowing can be considerably reduced. The lining is preferably longitudinally corrugated to promote inward deflection when pressurized. (UK)

22100 TRANSFER HOOD FOR HANDLING FUEL ASSEMBLIES IN NUCLEAR REACTORS AND ESPECIALLY FAST REACTORS. Aubert, M.; Merland, D.; Renaux, C. (to Commissariat a l'Energie Atomique). US Patent 3,915,792. 28 Oct 1975. Priority Date 8 Jun 1972, France. 8p.

A description is given of a hood for transferring fuel assemblies between two or more separate guide ramps inclined to the vertical at the same angle of slope and extending respectively through a first passage into the reactor vessel and through a second passage into a fuel-assembly storage chamber. The hood comprises at least one shielded duct joined to a flanged rotating portion which is so arranged that the open lower end of the shielded duct is positioned in the line of extension of one guide ramp and then the other as a result of displacement of the rotating portion. (Official Gazette)

22101 DEVICE FOR ACOUSTIC DETECTION IN A NUCLEAR REACTOR. Hanff, M.; Lions, N.; Peronnet, J. (to Commissariat a l'Energie Atomique). US Patent 3,913,407. 21 Oct 1975. Priority Date 22 Jul 1971, France. 6p.

A description is given of a device which comprises a first acoustic conductor placed vertically within the coolant liquid contained in a nuclear reactor vessel and a second coaxial acoustic conductor extending to the exterior of the reactor vessel. The device essentially comprises an accelerometer assembly for detecting signals delivered by the second conductor and an

amplifier which applies the detected signals to measuring instruments located outside the reactor vessel. The accelerometer comprises an amplifying pressure needle carried by the upper end of the second conductor, a piezoelectric ceramic element, a block fitted with a spring for applying the ceramic element against the needle and a preamplifier connected in series with the amplifier. (Official Gazette)

22102 FAST-NEUTRON REACTOR. Iljunin, V. G.; Murogov, V. M.; Shmelev, A. N. US Patent 3,912,583. 14 Oct 1974. Filed Date 30 Aug 1973. 12p.

A description is given of a fast-neutron reactor wherein the core and the surrounding lateral and axial blankets are made up of fuel element stacks. The walls of each stack have holes in the middle portion thereof with respect to the height of the core. Main and additional fuel elements are arranged respectively above and below the plane passing through the centers of the holes, inside each stack, the spacing between which fuel elements form, together with the holes, the inlet header of the coolant washing the fuel elements. The inlet header splits the coolant into two oppositely directed flows lead away by two outlet headers arranged above and below the upper and lower axial blankets. (Official Gazette)

22103 PLUTONIUM TRIFLUORIDE AS A FUEL FOR MOLTEN SALT REACTORS: SOLUBILITY STUDIES. Sood, D. D.; Iyer, P. N.; Prasad, R.; Vaidya, V. N.; Roy, K. N.; Venugopal, V.; Singh, Z.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay). Nucl. Technol.; 27: No. 3, 411-415(Nov 1975).

The feasibility of using plutonium as a fuel in a molten salt reactor has been evaluated by the determination of the solubility of PuF_3 in a number of salt compositions containing LiF, BeF_2, and ThF_4 in the temperature range of interest for such a reactor. An empirical correlation for the solubility of PuF_3 as a function of salt composition has been obtained from the solubility data to calculate the solubility of PuF_3 in other salt compositions of interest. The data indicate that PuF_3 has adequate solubility in salt compositions of interest for a molten salt reactor of either the converter or the breeder type. (auth)

22104 ASSESSMENT OF THE COOLANT VOIDING DYNAMICS FOLLOWING THE FAILURE OF PREIRRADIATED LMFBR FUEL PINS. Cronenberg, A. W. (Univ. of New Mexico, Albuquerque); Grolmes, M. A. Nucl. Technol.; 27: No. 3, 394-410(Nov 1975).

The flow transient for preirradiated fuel elements, brought to failure in a flowing sodium environment, was analyzed in terms of fission-gas-induced voiding. The analytic approach was based on single-phase isothermal expansion of the fission-gas bubble, which was assumed to be ideal and to fill the coolant-channel cross section uniformly. Gas discharge through the cladding breach was calculated using either the equation for critical or for subcritical flow, depending on the pin-to-bubble pressure ratio. The coolant was considered incompressible. (auth)

22105 MECHANICAL PROPERTIES OF UNIRRADIATED FAST REACTOR CLADDING DURING SIMULATED OVERPOWER TRANSIENTS. Hunter, C. W.; Fish, R. L.; Holmes, J. J. (Westinghouse Hanford Co., Richland, WA). Nucl. Technol.; 27: No. 3, 376-388(Nov 1975).

Internally pressurized specimens of unirradiated 20 percent cold-worked Type 316 stainless-steel cladding were rapidly heated and burst to determine mechanical behavior under various simulated reactor transient events. The tests were conducted at heating rates of 10 and 200 F^0/sec. Failure temperatures from 500 to 2500^{0}F were obtained, with the principal emphasis on the behavior above 1000^{0}F. The observed increase in ductility with increasing temperature was due to recovery and recrystallization of the cold-worked material, while the ductility decrease above 2100^{0}F resulted from grain growth. The diametral failure strains were between 0.5 to 1.0 percent at 1000^{0}F. The maximum diametral failure strain values reached 8 percent for the 10^{0}F/sec ramp and 4 percent for the 200^{0}F/sec ramp at the elevated temperatures. (auth)

22106 FAST-RESPONSE THERMOCOUPLE FOR TEMPERATURE FLUCTUATION MEASUREMENTS IN SODIUM COOLANTS. Bunschi, H. (Institut fuer Reaktortechnik, Wuerenlingen, Switzerland); Seifritz, W. Nucl. Technol.; 27: No. 3, 523-525(Nov 1975).

A special Chromel/Alumel thermocouple was fabricated whereby the bare ends of the wires were fixed 1 mm apart. In a medium with a good electrical conductivity (e.g., liquid sodium), the junction of the thermocouple is replaced by the medium itself. Hence, a fast undelayed response is expected. While mean temperature data of the device are in good agreement with data for conventional thermocouples, power spectral densities of the open element contain contributions from much higher frequencies than those of conventional thermocouples. (auth)

22107 SENSITIVITY STUDIES OF CLADDING RUPTURE LIFE WITH RESPECT TO PELLET DENSITY AND CLADDING THICKNESS FOR ADVANCED FUEL ELEMENTS. Yang, C. I.; Barthold, W. P. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 180-181(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22108 BIAXIAL CREEP CHARACTERISTICS OF GCFR CLADDING AT 650°C AND 32.4-KSI HOOP STRESS. Yaggee, F. L.; Purohit, A. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 182-183(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22109 IN-REACTOR CREEP OF 20% COLD-WORKED 316 STAINLESS-STEEL PRESSURIZED TUBES. Gilbert, E. R.; Bates, J. F. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 183-184(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22110 CORRELATION OF CREEP AND SWELLING WITH FUEL PIN PERFORMANCE. Jackson, R. J.; Washburn, D. F.; Garner, F. A.; Gilbert, E. R. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 184-185(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22111 RATIO OF YIELD-TO-ULTIMATE STRENGTH AS A MEASURE OF DUCTILITY FOR HIGHLY IRRADIATED AUSTENITIC STAINLESS STEELS. Vaidyanathan, S. (General Electric Co., Sunnyvale, CA); Nelson, D. V.; Blackburn, L. D. Trans. Am. Nucl. Soc.; 22: 185(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22112 IN-REACTOR STRESS RELAXATION IN BENDING OF 20% COLD-WORKED 316 STAINLESS STEEL. Kenfield, T. A.; Busboom, H. J.; Appleby, W. K. (General Electric Co., Sunnyvale, CA). Trans. Am. Nucl. Soc.; 22: 185-186(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22113 CLADDING OVALITIES IN ADVANCED LMFBR FUEL ELEMENTS. Kerrisk, J. F.; Barner, J. O.; Petty, R. L. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 186-187(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22114 IRRADIATION OF THE MARK-IA METALLIC FUEL ELEMENTS WITH BOND SODIUM DEFECTS TO THEIR BURN-UP LIMIT IN EBR-II. Koenig, J. F.; Hayner, G. O. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 188-189(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22115 FISSION PRODUCT RELEASE AND POSTIRRADIATION EXAMINATION OF MARK-II METALLIC FUEL ELEMENT IRRADIATED TO END-OF-LIFE CONDITIONS IN EBR-II. Koenig, J. F.; Hayner, G. O. (Argonne National Lab., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 189-190(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22116 CLADDING FAILURE OBSERVATIONS ON EXPERIMENTAL MARK-IA DRIVER FUEL IRRADIATED IN EBR-II. Olson, N. J. (Battelle Northwest Labs., Richland, WA); McClellan, G. C.; Lehmann, J. L. Trans. Am. Nucl. Soc.; 22: 190-191(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22117 FAILURE OBSERVATIONS ON ENCAPSULATED EXPERIMENTAL MARK-II FUEL ELEMENTS IRRADIATED IN EBR-II. Olson, N. J. (Battelle Northwest Labs., Richland, WA); Flinn, J. E.; Johnson, K. A. Trans. Am. Nucl. Soc.; 22: 191-192(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22118 APPLICATION OF FRACTURE MECHANICS TO MARK-II DRIVER ELEMENT CLADDING. Chopra, P. S.; Wu, T. S.; Hofman, G. L. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 192-193(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22119 RESIDUAL COLD WORK AND ITS INFLUENCE ON TENSILE PROPERTIES OF TYPES 304 AND 316 STAINLESS STEELS. Sikka, V. K.; Swindeman, R. W.; Hebble, T. L.; Booker, M. K. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 198-199(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22120 EFFECT OF CARBON ON THE CREEP-RUPTURE PROPERTIES OF 2¼ Cr–1 Mo STEEL WELDMENTS. Klueh, R. L.; Cannonico, D. A. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 199-200(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22121 SELF-WELDING EVALUATION OF REACTOR MATERIALS IN FLOWING SODIUM. Chang, J. Y.; Flagella, P. N.; Schrock, S. L. (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 200-202(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22122 APPARATUS TO SIMULATE IN-REACTOR HEATING CONDITIONS IN ADVANCED FUELS. Wrona, B. J.; Johanson, E.; Galvin, T. M. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 220(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22123 STARTUP AND INITIAL OPERATION OF THE HIGH-TEMPERATURE SODIUM FACILITY. Duncan, H. C.; Waldo, J. B. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 221-222(Nov 1975).
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22212 SHIELDING CALCULATIONS FOR A 300-MW(e) GAS-COOLED FAST BREEDER REACTOR. Bartine, D. E. (Oak Ridge National Lab., TN); Pace, J. V. III; Williams, L. R.; Knight, J. R. Trans. Am. Nucl. Soc.; 22: 786-787(Nov 1975).
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22214 CLINCH RIVER BREEDER REACTOR (CRBR) SHIELDING CONSIDERATIONS TO ASSURE STRUCTURAL INTEGRITY. Wrights, G. N. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 788-789(Nov 1975).
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22215 PLANT SHIELDING DESIGN OF CLINCH RIVER BREEDER REACTOR PLANT (CRBRP). Kim, C. M. (Burns and Roe, Paramus, NJ). Trans. Am. Nucl. Soc.; 22: 789-790 (Nov 1975).
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22216 (CNLM-4043) DESIGN CRITERIA FOR LITHIUM-COOLED REACTOR EXPERIMENT (LCRE) AT NRTS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 27 Apr 1962. 52p. Dep. NTIS $4.50.
Design criteria for reactor test and support facilities utilizing existing structures at the former ANP area of the National Reactor Testing Station (NRTS) near Idaho Falls, Idaho are presented. The information and specifications presented establish the basis for the design of facilities providing the capability for installation, extended nuclear testing and remote disassembly of the 10 MW Lithium-Cooled Reactor Experiment (LCRE). Facility structural and process design has been developed to the extent required to assure the safety and technical feasibility of the proposed facilities for reactor operation. (auth)

22217 (CONF-750117-P2, pp 929-948) LOOP DESIGN IN TRR FOR TEST AND DEVELOPMENT OF HWOCR FUELS, COOLANTS AND MATERIALS. Yao, S. L.; Feng, C. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). 1975.
From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).
In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).
The TRR Organic Loop is an irradiation facility in the Taiwan Research Reactor designed to accept pressurized organic coolant OS-84. The experimental program will study the effects of irradiation on fuel design, cladding materials, pressure tube materials and coolant chemistry for the development of the HWOCR power reactor. The reason for building the loop, a general description of the loop and its components and auxiliary systems, the safety analysis, and a summary of the design calculations are presented. (auth)

22218 (EUR-5395(Vol.2), pp 477-495) HIGH TEMPERATURE THERMOCOUPLE APPLICATIONS IN THE R2 REACTOR AT STUDSVIK, SWEDEN. Rohne, B. 1975.
From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).
In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

In the experimental rigs for the irradiation of coated particles at temperatures up to 1600°C several types of thermocouple have been used: platinum-platinum 10% rhodium, tungsten 5% rhenium-tungsten 26% rhenium, tungsten 3% rhenium-tungsten 25% rhenium and platinum 0.1% molybdenum-platinum 5% molybdenum. Specifications, installation and behavior during irradiation (failure rate and decalibration) are discussed. Although only a few thermocouples of the platinum-molybdenum type have been tested, this seems to be the most suitable for temperature measurements in graphite up to 1500°C in view of the low decalibration rate. The decalibration is almost linear with thermal flux and is about +2% at a thermal neutron fluence of $8 \cdot 10^{24}$ m^{-2} and about 900°C. (auth)

22219 (HEDL-SA-753) NONLINEAR SEISMIC ANALYSIS OF A REACTOR STRUCTURE WITH IMPACT BETWEEN CORE COMPONENTS. Hill, R. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 22p. (CONF-7509106-1). Dep. NTIS $3.50.

From 4th MASTRAN user's colloquium; Lanley Field, Virginia, United States of America (USA) (9 Sep 1975).

The seismic analysis of the FFTF-PIOTA (Fast Flux Test Facility-Postirradiation Open Test Assembly), subjected to a horizontal DBE (Design Base Earthquake) is presented. The PIOTA is the first in a set of open test assemblies to be designed for the FFTF. Employing the direct method of transient analysis, the governing differential equations describing the motion of the system are set up directly and are implicitly integrated numerically in time. A simple lumped-mass beam model of the FFTF which includes small clearances between core components is used as a "driver" for a fine mesh model of the PIOTA. The nonlinear forces due to the impact of the core components and their effect on the PIOTA are computed. 6 references. (auth)

22220 (HEDL-TME-74-2(Vol.2)) HEDL QUARTERLY TECHNICAL REPORT, APRIL–JUNE 1974. Volume 2. Fuels and Safety Engineering. Evans, E. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-2170. 77p. AT.

The status of fast flux mixed oxide fuel irradiations is reviewed, and progress is summarized in FFTF component fabrication activities. (DG)

22221 (HEDL-TME-75-54) THERMAL HYDRAULIC ANALYSIS: IDS EMERGENCY COOLING. Guzek, J. C. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1975. Contract AT(45-1)-2170. 55p. AT.

Technical adequacy of cooling of the Interim Decay Storage (IDS) facility of the FFTF under emergency conditions of total electrical power loss with only natural circulation air from containment has been evaluated. The hydraulic characteristics of the cooling system are presented in parametric form. Detail temperature distributions are reported for transient and steady-state operations which were calculated for two conditions of decay heat loadings: 100 KW; and 240 KW. Temperatures calculated in principal structural locations of the IDS for all conditions of emergency operation, including non-uniform loading are below respective allowable values. Results indicate that the IDS can be safely cooled by natural circulation during emergency loss of electrical power. (auth)

22222 (HEDL-TME-75-88) FEASIBILITY OF EVALUATING THE INTEGRITY OF FTR DUCT TO END FIXTURE WELDS USING ACOUSTIC EMISSION MONITORING. Trantow, R. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov. 1975. Contract E(45-1)-2170. vp. Dep. NTIS $6.00.

A method of applying real-time acoustic emission (AE) source location to evaluate the integrity of duct-to-end fixture welds was developed and evaluated using the HEDL R8-4 AE monitor coupled with a PDP-8e minicomputer. Operational software was developed to control the system's data acquisition, storage, and display functions. Performance was evaluated on the basis of comparisons between AE source location data and subsequent destructive examination of six duct-to-transition ring qualification welds. Ten separate discontinuities seen in the metallography performed at 35 locations along these welds correlated with the averaged acoustic emission activity revealed by the AE source location maps. This relationship is not presently considered to be usable as a system calibration method however, because of the limited range of discontinuity lengths (from 0.0003 to 0.004 in. long) that were correlated. The presence of six other discontinuities, found in regions showing low levels of emission activity, indicated that significant stress risers can go undetected under the conditions investigated. (auth)

22223 (LMEC-TDR-75-7) FFTF THERMOWELL SECONDARY SEAL TEST. Burns, W. E.; DeVita, V. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 1975. 50p. AT.

The results of testing two thermowell secondary seals to the requirements of HWS 1573 and RDT Standard C 7-18T are described. The tests were designed to simulate a massive failure of the thermowell probe internal to the sodium pipe by allowing sodium, from a reservoir maintained at 1200°F and 250 psig, to be applied directly to the secondary seal for a period of 4 hr. No evidence of sodium leakage past the secondary seal was observed on either test assembly. (auth)

22224 (WARD-2171-53) ANALYSIS OF SEALING EFFECTIVENESS OF FFTF HEAD COMPARTMENT COMPONENTS. Court, A. J. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). May 1975. Contract E(45-1)-2171. 112p. AT.

Capability for continuous operation of the reactor with up to 1 percent fuel cladding failures is a principal design basis for the FFTF. To provide an acceptable environment in the head compartment for routine surveillance and maintenance, the airborne activity level is limited to 0.1 MPC/sub a/. By limiting leakage through the reactor vessel head and head mounted components the airborne activity level can be controlled effectively—even for the limiting design condition of 1 percent failed fuel. The sources of radioactive gas are described and the methods of analysis used to determine sealing effectiveness of each component are presented. Results of seal tests, combined with the analytical methods, demonstrate that the desired sealing effectiveness can be achieved for each component. The summary of seal leakage for head components is given. 33 references. (auth)

22225 NEUTRON SPECTRAL DISTRIBUTION FROM A GODIVA TYPE CRITICAL ASSEMBLY. Meason, J. L.; Wright, H. L.; Hogan, J. C.; Harvey, J. T. (Univ. of Arkansas, Fayetteville). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2330-2335(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Neutron spectrum measurements were made at the White Sands Missile Range (WSMR) Fast Burst Reactor (FBR), a Godiva type critical assembly. The spectrum measurements were performed by neutron activation techniques coupled with the computer code SAND II. Results from this investigation reveal a spectral index of 6.7 for the leakage spectrum and 7.8 for the Glory Hole spectrum or, the neutron leakage spectrum of this Godiva type critical assembly is harder by approximately 30 percent when comparing its spectral index to previous measurements. Furthermore, the neutron spectrum measured in the Glory Hole for the FBR reveals that this spectrum is softer than the leakage spectrum by a factor of 1.16 for the spectral indices. (auth)

22226 3-MW LIVERMORE POOL-TYPE REACTOR NEUTRON RADIOGRAPHIC FACILITY. Richards, W. J.; Peterson, R. T.; Prindle, J. P. (Univ. of California, Livermore). Trans. Am. Nucl. Soc.; 22: 131-133(Nov 1975).

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The distribution is considered of time intervals between a count in one neutron detector and the consequent event registered in a second one. A "four interval" probability generating function was derived by means of which the expression for the distribution of the time intervals, lasting from triggering detection in the first detector to subsequent count in the second one could be obtained. The experimental work was conducted in the zero thermal power reactor Crocus, using a neutron source provided by spontaneous fission, a BF_3 counter for the first detector, and an He_3 detector for the second instrument. (UK)

22276 FAST-NEUTRON HODOSCOPE AT TREAT: DEVELOPMENT AND OPERATION. De Volpi, A.; Pecina, R. J.; Daly, R. T.; Travis, D. J.; Stewart, R. R.; Rhodes, E. A. (Argonne National Lab., IL). Nucl. Technol.; 27: No. 3, 449-487(Nov 1975).
A description is given of a fast-neutron hodoscope to detect fuel motion within test samples inserted in the center of the Transient Reactor Test Facility (TREAT) reactor core. The fuel motion is induced under simulated hypothetical conditions. The hodoscope system includes components necessary to acquire, store, decode, and process the collected data. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 19774 and 22327.

Propulsion and Package Reactors

Refer also to abstracts 20200, 20621, 20627, 20831, and 22187.

22277 (73SD4220(Vol. 2)) NUCLEAR ELECTRIC PROPULSION MISSION ENGINEERING STUDY COVERING THE PERIOD APRIL 1971 TO JANUARY 1973. Volume II. Final Report. (General Electric Co., Philadelphia, Pa (USA). Space Div.). Mar 1973. Contract JPL 953104. 262p. Dep. NTIS $9.00.
For Jet Propulsion Lab., Pasadena, CA.
The results of a mission engineering analysis of nuclear-thermionic electric propulsion spacecraft for unmanned interplanetary and geocentric missions are summarized. Critical technologies assessed are associated with the development of Nuclear Electric Propulsion (NEP), and the impact of its availability on future space programs. Specific areas of investigation include outer planet and comet rendezvous mission analysis, NEP Stage design for geocentric and interplanetary missions NEP system development cost and unit costs, and technology requirements for NEP Stage development. A multi-mission NEP Stage can be developed to perform both multiple geocentric and interplanetary missions. Development program costs for a 1983 launch would be of the order of $275 M, including hardware and reactor development, flight system hardware, and mission support. Recurring unit costs for flight NEP systems would be of the

order of $25 M for a 120kWe NEP Stage. Identified pacing NEP technology requirements are the development of 20,000 full power hour ion thrusters and thermionic reactor, and the development of related power conditioning. The resulting NEP Stage design provides both inherent reliability and high payload mass capability. High payload mass capability can be translated into both low payload cost and high payload reliability. NEP Stage and payload integration is compatible with the Space Shuttle. (auth)

22278 (AI-ERDA-13163) SYSTEMS FOR NUCLEAR AUXILIARY POWER. Annual Report, Government Fiscal Year 1975. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Sep 1975. Contract AT(04-3)-701. 167p. Dep. NTIS $7.60.

The system and component engineering and test activities relating to the ZrH reactor are described. The specific objectives which were pursued during FY 1975 were to: investigate standardized ZrH reactor-TE, -Brayton, and -organic Rankine space power systems and components; perform conceptual analysis and design of ZrH reactor-organic Rankine power systems for subsea applications; perform tests on key space system components; conduct fuel hydriding and hydrogen barrier investigations; and perform system studies in support of the Department of Defense (DOD) and their contractors as directed by the Energy Research and Development Administration (ERDA). (auth)

22279 (CNLM-149) ESTIMATED PERFORMANCE AND WEIGHT DATA FOR ALL-NUCLEAR SEA LEVEL POWERPLANTS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). [nd]. 3p. Dep. NTIS $3.50.

Declassified 12 Jan 1976.

Performance and weight data for lithium- and sodium-cooled aircraft propulsion reactors are presented. (JWR)

22280 (CNLM-347-1) PROPOSAL PRESENTATION MARITIME GAS-COOLED REACTOR POWERPLANT PICTORIAL SUMMARY. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). [nd]. 15p. Dep. NTIS $3.50.

A pictorial summary of facilities and test equipment is presented for the maritime gas-cooled reactor proposal. (JWR)

22281 (CNLM-831) FAST AIRCRAFT REACTOR DATA FOR BOEING AIRCRAFT. Chalfant, A. I. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 9 Jun 1958. 3p. Dep. NTIS $3.50.

Declassified 12 Jan 1976.

Tables of characteristics representing the conservative and optimistic extremes of the range of fast aircraft reactor designs are presented. (JWR)

22282 (CNLM-1848) ENGINEERING PROPOSAL FOR SUPPORT OF RESEARCH AND DEVELOPMENT WORK ON MATERIALS AND PROPULSION EQUIPMENT COMPONENTS OF AIRCRAFT NUCLEAR PROPULSION SYSTEM. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 29 Jul 1959. 21p. Dep. NTIS $3.50.

Declassified 8 Dec 1975.

22283 (CNLM-2656) PWAR-11C CORE REMOVAL. Hahnel, W. F.; Stebbings, R. C. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 21 Jun 1960. 7p. Dep. NTIS $3.50.

Declassified 15 Jan 1976.

Directions are provided for the removal and disassembly of the core of PWAR-11C. This operation is to be done remotely in an inert atmosphere 72 days after the test reactor is shut down. (LTN)

22284 (CNLM-4149) PRESENTATION BY E. R. DYTKO, L. M. RARING, R. M. MEYER AND C. E. HOLTSINGER, JR. TO UNITED STATES ATOMIC ENERGY COMMISSION. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 20 Jun 1962. Contract AT(30-1)-2789. 42p. Dep. NTIS $4.00.

Declassified 5 Dec 1975.

A presentation on the SNAP 50 reactor development status to the USAEC has been documented. This involves a nuclear reactor and associated Rankine power cycle system. The nuclear reactor was cooled with lithium, which heated potassium, which was the working fluid in the Rankine power system and drove the turbogenerators. Various fuel (UC) and material development programs (niobium alloys and protective coatings) are discussed briefly. Component weights are estimated and proposed development and funding schedules are given. (LTN)

22285 (CNLM-4335) SNAP-50 SPACE POWERPLANT. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 28 Nov 1962. Contract AT(30-1)-2789. 11p. Dep. NTIS $3.50.

Design characteristics of the SNAP 50 reactor are presented. The SNAP 50 development program is reviewed. (DCC)

22286 (CNLM-5007(Vol. 1)) BUSINESS MANAGEMENT PROPOSAL CAVITATION DAMAGE RESEARCH FOR MECHANICAL PUMPING OF HIGH TEMPERATURE LIQUID METAL. Doll, W. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 9 May 1963. 45p. Dep. NTIS $4.00.

The work required to meet the specifications of SEPO 1034 is described. In addition, an alternate statement of work is submitted for consideration. The work described in the Statement of Work is proposed on a cost-plus-fixed-fee basis for a total estimated cost of $303,007 which includes a fixed fee of $27,546. The Alternate Statement of Work, can be performed for a total cost of $331,705 which includes a fixed fee of $30,155. A detailed cost estimate is included. (auth)

22287 (CNLM-5227) SNAP-50 FUEL DEVELOPMENT SUMMARY FOR AUGUST 1963. Raring, L. M. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 26 Aug 1963. Contract AT(30-1)-2789. 3p. Dep. NTIS $3.50.

The progress reported include fabrication activities, pin testing, and compatibility testing. (DLC)

22288 (CNLM-5325(Vol.5)) SECOND GENERATION PORTABLE NUCLEAR POWERPLANT. Volume V. Contractor Qualification and Management Data. Proposal. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). [nd]. 130p. Dep. NTIS $6.00.

The qualifications of the several organizations which will participate in this proposed Second Generation Portable Nuclear Powerplant Program are outlined and the Management Approach described. The prime contractor will be Pratt & Whitney Aircraft-CANEL, Middletown, Connecticut, a Division of the United Aircraft Corporation. It is proposed to perform the work at the Connecticut Advanced Nuclear Engineering Laboratory (CANEL), Middletown, Connecticut. Associated Nucleonics, Inc., a Subsidiary of Stone & Webster Engineering Corporation, is proposed as a major subcontractor responsible for providing architect-engineering services to Pratt & Whitney Aircraft. Modification of an existing gas turbine engine, the FT-12, for this application would be undertaken by Pratt & Whitney Aircraft, East Hartford, Connecticut. (auth)

22289 (CNLM-5449) PROGRESS ON SNAP-50 FUEL DEVELOPMENT DURING DECEMBER 1963. Freed, M. S. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 3 Jan 1964. Contract AT(30-1)-2789. 6p. Dep. NTIS $3.50.

The progress reported included irradiation specimen an[4] capsule fabrication, status of irradiation testing, post test examination of capsules (data tables are presented for UN and UC fuel), and compatibility tests. (DLC)

22290 (CNLM-5558) EXCERPT FROM PWAC-634 CONSISTING OF REACTOR AND SHIELD DEVELOPMENT SECTION. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 27 Feb 1964. 84p. Dep. NTIS $5.00.

Declassified 3 Nov 1975.

Design and development progress on the SNAP 50 reactor is reported. Shielding (including radiation heating), neutron reflectors and control concepts are covered. Best fuel elements (enriched uranium as the carbide) are treated in more detail: fabrication, test results, swelling at different degrees of burnup, fuel-cladding compatibility, metallography, etc. (LTN)

22291 (CNLM-5631) IDENTIFICATION AND SERIALIZATION STANDARDS INSTRUMENTATION, CONTROLS AND HARDWARE. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 15 Apr 1964. Contract AT(30-1)-2789. 22p. Dep. NTIS $3.50.

Identification codes are presented to establish standard practices and to promote consistency in the presentation of all instrumentation flow diagrams, electrical drawings and control piping drawings developed by Pratt & Whitney Aircraft-CANEL. (auth)

22292 (CNLM-5662) PERFORMANCE STUDY OF TWO-PHASE WATER TESTS ON PLUG AND SHARP-EDGED TYPE ORIFICES. Meregian, J. V. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Jun 1964. Contract AT(30-1)-2789. 21p.

Plots of pressure drop versus flow rate of water flashing across an orifice showed that flow through a plug-type orifice (having discrete length) reached a limit, dependent on pressure, when flashing occurred while flow through a sharp-edged (zero-length) orifice was independent of pressure and did not reach a limit with the on-set of flashing. (auth)

22293 (CNLM-5713) VISUAL MATERIAL PRESENTED DURING THE NASA-AEC MEETING AT CANEL ON MAY 11-

12, 1964. Parks, G. U. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 11 Jun 1964. 133p. Dep. NTIS $6.00.

The visual material presented on the SNAP-50 reactor components cover the reactor and shield, Rankine cycle boiler, materials, high-temperature instrumentation, and pump. (DLC)

22294 (CNLM-5940(Vol.1)) BUSINESS MANAGEMENT PROPOSAL PUMP IMPELLER CAVITATION DAMAGE INVESTIGATION. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 29 Oct 1964. 48p. Dep. NTIS $4.00.

The necessary personnel, services, and materials to conduct investigations of cavitation damage of an existing mechanical pump impeller operating in an existing high-temperature potassium test facility are listed. Water tests of the impeller shall also be conducted in another existing test facility to establish a basis for calibration and correlation of the degree of cavitation occurring in the hot liquid metal tests. As an alternate Statement of Work, it is proposed to conduct, in addition to the basic program, one cavitation test of a rotating disk in high-temperature potassium incorporating multiple material specimens and utilizing an existing test unit and test facility. This test will provide direct comparisons of the nature of cavitation pitting damage of the cast type 316 stainless steel material used in the pump impeller test and other materials of interest to the NASA. (auth)

22295 (CNLM-5940(Vol. 2)) TECHNICAL PROPOSAL PUMP IMPELLER CAVITATION DAMAGE INVESTIGATION. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 29 Oct 1964. 74p. Dep. NTIS $4.50.

In response to request for proposal number 203540 issued by the National Aeronautics and Space Administration at the Lewis Research Center, Pratt & Whitney Aircraft-CANEL proposes to furnish the necessary personnel, services and materials for a period of 18 months to conduct the investigation described. This proposal describes an investigation of cavitation damage of mechanical pump impellers operating in 1400F potassium. A series of water calibration tests of the impeller is proposed preceding the liquid metal test to establish a basis for correlation of the degree of cavitation occurring in the hot liquid metal tests. It is further proposed to conduct a rotating disk cavitation test in 1400F potassium which will contain specimens of type 316 stainless steel from the test impeller casting plus other materials of interest to the NASA. This test will provide a basis for ranking of materials with regard to cavitation damage resistance in high temperature potassium. Through this test a direct comparison can be made between an accelerated cavitation test device and actual impeller operation. (auth)

22296 (CNLM-6192) SNAP-50/SPUR NUCLEAR TEST FACILITY DESIGN CRITERIA CANEL SITE, MIDDLETOWN, CONNECTICUT. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 19 May 1965. Contract AT(30-1)-2789. 80p. Dep. NTIS $5.00.

The technical design criteria for a Nuclear Test Facility to be located at the Connecticut Advanced Nuclear Engineering Laboratory (CANEL) in Middletown, Connecticut are presented. The information establishes the basis for the design of a facility having the capability of handling the assembly, extended nuclear testing, and remote disassembly of lithium-cooled reactor tests to power levels up to 2.5 Mw thermal. (auth)

22297 (EUR-5395(Vol.2), pp 509-532) EXPERIENCES WITH W3Re/W25Re THERMOCOUPLES IN FUEL PINS OF NS OTTO HAHN'S TWO CORES. Kolb, M. (GKSS, Geesthacht, Ger.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Included are discussions on applications, performance, and decalibration. Also dealt with is the measurement of effective thermocouple time constants and of fuel rod heat transfer time constants utilizing the reactor noise and the resulting small temperature fluctuations. (auth)

22298 (FPS-C-59) PRELIMINARY SPECIFICATION FOR THE HELIUM SYSTEM OF THE LIQUID METAL PUMPS. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). [nd]. 8p. Dep. NTIS $3.50.

Declassified 10 Dec 1975.

Design requirements for the helium system of the liquid metal pump seals, expansion tank or sump, and associated lubricating oil sumps are described. (auth)

22299 (NAA-SR-Memo-12023) ANNOTATED BIBLIOGRAPHY: SNAP 10A PROGRAM. Lilja, D. G. (Atomics International Div., Canoga Park, Calif. (USA)). 1 Oct 1966. Contract AT(11-1)-Gen-8. 258p. Dep. NTIS $9.00.

An annotated bibliography of the SNAP 10A program documents is presented in the following arrangement: subject index, numerical index, SNAP 10A papers, and SNAP progress reports. (DCC)

22300 (NAA-SR-TDR-8301(Rev.3)) BIBLIOGRAPHY, SNAP PROGRAM REPORTS, MEMOS, AND MOTION PICTURES. Technical Reports and Presentations. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Apr 1966. Contract AT(11-1)-Gen-8. 241p. Dep. NTIS $8.00.

22301 (NSPM-3) NUCLEAR ELECTRIC ION PROPULSION SYSTEM FOR AN INTERPLANETARY VEHICLE. Kardys, C. F.; Walton, J. W.; Woods, T. J. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 15 Jan 1959. 116p. Dep. NTIS $5.50.

Declassified 9 Dec 1975.

An investigation of an Ion Propelled Space Vehicle using a nuclear reactor for the primary heat source and conventional, turbine driven, electric machinery was made to determine the feasibility of this type of system. An ion power plant consists of three basic components: an energy source, machinery to convert the energy into electrical form, and an ion accelerator. The thrust is supplied to the space vehicle by the ion accelerator which ejects ions at a high velocity by means of a large electric potential. Theoretically, the velocity of ejection is limited only by the relativistic effect of increasing mass as the particle approaches the velocity of light. As in a conventional rocket, the thrust is given by the product of mass flow rate and the velocity of ejection. Ion propulsion is characterized by a high specific impulse and low thrusts as compared to conventional and nuclear rockets. This report is devoted mainly to the application of ion propulsion to a vehicle capable of an unmanned Earth orbit to Mars orbit and return mission. Certain areas of uncertainty exist because of the extension of known data into new applications. This is particularly true in the case of the weight and size of components (such as the accelerator and the space radiator) required to give the estimated performance. (auth)

22302 IN-REACTOR HIGH-TEMPERATURE UO_2 BEHAVIOR. Stora, J. P.; Kauffmann, Y. (CEN, Grenoble, France). Trans. Am. Nucl. Soc.; 22: 207-208(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Reactor Safety and Environmental Aspects

Refer also to abstracts 19670, 19795, 20181, 20225, 20239, 20505, and 20880.

22303 (ANCR-1236) EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1 TESTS S-02-9 AND S-02-9A (BLOWDOWN HEAT TRANSFER TESTS). (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Jan 1976. Contract E(10-1)-1375. 142p. Dep. NTIS $7.75.

Recorded test data are presented for Tests S-02-9 and S-02-9A of the Semiscale Mod-1 blowdown heat transfer test series. These tests are among several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a water-cooled nuclear reactor system and to provide data for the assessment of the Loss-of-Fluid Test (LOFT) design basis. Tests S-02-9 and S-02-9A were conducted from initial cold leg fluid temperatures of 542 and 544°F, respectively, and initial pressures of 2,253 and 2,263 psia, respectively. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with full core power (1.6 MW). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core. System flow was set to achieve full core temperature differential (66°F). The flow resistance of the intact loop was based on core area scaling. During system depressurization, core power was reduced from the initial level of 1.6 MW in such a manner as to simulate the surface heat flux response of the LOFT nuclear fuel rods until such time that departure from nucleate boiling occurs. Both tests were conducted with a flat radial power profile. Blowdown to the pressure suppression system was accompanied by simulated emergency core cooling injection into both the intact and broken loops. However, pressure suppression system coolant spray was not used. (auth)

22304 (ANCR-1262) QUARTERLY TECHNICAL REPORT ON WATER REACTOR SAFETY PROGRAMS SPONSORED BY THE NUCLEAR REGULATORY COMMISSION'S DIVISION OF

REACTOR SAFETY RESEARCH, APRIL-JUNE 1975. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Nov 1975. Contract E(10-1)-1375. 226p. Dep. NTIS $7.60.

The current water reactor safety activities of ANC are accomplished in four programs. The Semiscale Program consists of small-scale nonnuclear thermal-hydraulic experiments for the generation of experimental data that can be applied to analytical models describing loss-of-coolant accident (LOCA) phenomena in water-cooled nuclear power plants. Emphasis is placed on acquiring system effects data from integral tests that characterize the most significant thermal-hydraulic phenomena during the depressurization (blowdown) and emergency cooling phase of a LOCA. The LOFT Program provides test data to support: (a) assessment and improvement of the analytical methods utilized for predicting the behavior of pressurized water reactors (PWR) under LOCA conditions; (b) evaluation of the performance of PWR engineered safety features (ESF), particularly the emergency core cooling system (ECCS); and (c) assessment of the quantitative margins of safety inherent in the performance of these safety features. The Thermal Fuels Behavior Program is a program designed to provide information on the behavior of reactor fuels under normal, off-normal, and accident conditions. The experimental portion is concentrated on testing of single fuel rods and fuel rod clusters under power-cooling-mismatch (PCM), loss-of-coolant, and reactivity initiated accident conditions. The Reactor Behavior Program encompasses the analytical aspects of predicting the response of nuclear power reactors under normal, abnormal, and accident conditions. The status of each program is reported. (auth)

22305 (BNL-50460) HTGR SAFETY EVALUATION DIVISION QUARTERLY REPORT, APRIL 1, 1975–JUNE 30, 1975. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. Contract E(30-1)-16. 30p. Dep. NTIS $7.00.

Information is presented concerning fission product release and transport, primary coolant impurities, rapid graphite oxidation, structural evaluation, materials, instrumentation and monitoring, and phenomena modeling and systems analysis. (DCC)

22306 (CEA-R-4693) CONTRIBUTION TO THE INTERPRETATION OF EXPLOSIVE PHENOMENA IN RESEARCH LIGHT-WATER REACTORS. Le Berre, F. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Div. d'Etudes et de Developpement des Reacteurs). Aug 1975. 147p. (In French). Dep. NTIS (US Sales Only) $6.00.

Thesis. Submitted to Aix-Marseille Univ., France.

The prediction of the transient behavior of a light-water reactor that undergoes a power excursion due to a step reactivity insertion is examined. In particular, a film-model for boiling is developed, which takes into account fast heat transfers, and permits the description of the water-hammer phenomena. The latter is due to the sudden contact between the liquid coolant and the fuel plates, which results from the vanishing of the vapor film. It is shown in which conditions this phenomena may initiate a reactor explosion. (auth)

22307 (CENPD-190) CEA INJECTION: C-E METHOD FOR CONTROL ELEMENT ASSEMBLY EJECTION ANALYSIS. Peeler, G. B.; Kennedy, M. F.; Miller, G. D.; Ritterbusch, S. E.; Kin, L. K. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jan 1976. 97p. Combustion Engineering, Inc., Windsor, CN.

The synthesis method used at Combustion Engineering for analyzing a Control Element Assembly (CEA) Ejection transient is described and shown to be conservative relative to three-dimensional space-time kinetics calculations. The synthesis method utilizes zero, one, and two-dimensional calculations to determine the maximum fuel energy content, and the fuel and clad temperatures during a CEA ejection transient. 19 references. (auth)

22308 (CONF-750117-P1, pp 379-400) SEISMIC REQUIREMENTS FOR NUCLEAR POWER PLANTS. Liu, S. N. (Battelle Pacific Northwest Labs., Richland, WA). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The purpose of seismic design of nuclear power plants is to insure adequate protection of the public from any potential exposure to nuclear radiation that might result from an earthquake-induced structural failure. It is necessary to ensure that the reactor can be shut down and maintained in a safe shutdown condition during and following an earthquake. Components and systems important to safety must remain functional. The criteria for seismic design of nuclear reactor plants are outlined. Some important characteristics that need to be included in both analytical approach and experimental verification are also identified. (auth)

22309 (CONF-750117-P1, pp 401-417) SITING OF NUCLEAR POWER PLANTS IN TAIWAN. Shiao, S. C.; Shieh, C. I. (Taiwan Power Co., Taipei). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The process of nuclear power plant site selection in Taiwan is described. Topics discussed include topography, geology, seismology, meteorology, and human population distributions. (JWR)

22310 (CONF-750117-P2, pp 601-620) SAFETY AND RISKS OF NUCLEAR POWER. Rasmussen, N. C. (Massachusetts Inst. of Tech., Cambridge). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The results of the WASH-1400 Reactor Safety Study are reviewed. (JWR)

22311 (CONF-750117-P2, pp 701-713) SAFETY DESIGNS OF TAIPOWER'S NUCLEAR POWER PLANTS. Chen, J. H.; Lin, E. (Taiwan Power Co., Taipei). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

Although nuclear power has many advantages from the economical and environmental points of view, it involves special safety problems due to the fact that the reactor contains a large quantity of radioactive materials. Safety considerations, therefore, are in the design, construction, and operation of a nuclear power plant. The utility should take full responsibility to assure the plant operation without undue risk to the safety and health of the general public. The surveillance and supervision for the safety and health of the public are held by Atomic Energy Council through the licensing application. Various safety aspects of the Chinshan and Kuosheng plants are described. Efforts that Taipower have made to improve the safety aspects of the plants are also described. (auth)

22312 (CONF-750117-P2, pp 749-759) RADIATION PROTECTION IN TAIPOWER NUCLEAR POWER PROJECT. Su, P. C.; Chyen, P. C. (Taiwan Power Co., Taipei). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

A general description of Taipower's radiation protection program which was launched in 1971 as a part of Taipower's nuclear power project is presented. The policy, organization and the current status of the progress in implementation of the said program is discussed. Basically, Taipower follows the regulatory requirements set forth by ROCAEC, which are virtually the same as those of USAEC. The ultimate goal of the program is closely tied with the Taipower nuclear project to assure that the harmful influence of radiation exposures resulting from nuclear power generation to the public and the radiation workers meets "As Low As Practical" policy. (auth)

22313 (CONF-750117-P2, pp 761-787) CONTAINMENT CONFIGURATIONS AND LOCA LOADINGS. Patti, F. J. (Burns and Roe, Inc., Hempstead, NY). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

Characteristics of dry, ice condenser, and pressure suppression containment systems are reviewed. The analysis of LOCA pressure and temperature transients in these systems is discussed. (JWR)

22314 (CONF-750117-P2, pp 907-928) PRELIMINARY SAFETY EVALUATION OF THE CONCEPTUAL 600 MW(e) HEAVY-WATER-MODERATED ORGANIC-COOLED POWER REACTOR. Cheng, W. T. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

A preliminary safety study on the conceptual design of a 600 MW(e) heavy water moderated organic cooled power reactor (HWOCR) is presented. Descriptions of the design criteria of the plant are included. Potential hazards including coolant flammability, reactivity accident and loss-of-coolant accident resulting from a major rupture of the inlet mixing header are evaluated. Results of the evaluation show that the HWOCR plant would not create a radioactive hazard worse than that of the conventional water reactors, but intensive research and development programs must be undertaken to support further detailed designs. (auth)

22315 (COO-2554-3) HEAT TRANSFER FROM BUBBLING POOLS. Progress Report, July 1, 1975-October 1, 1975. Bankoff, S. G.; Luk, A. (Northwestern Univ., Evanston, Ill. (USA)). 1975. Contract AT(11-1)-2554. 25p. Dep. NTIS $3.50.

It is shown that the heat transfer characteristics of volume-heated boiling pools can be successfully modeled by non-boiling pools with internal gas injection. The strong influence of spatial distribution of bubble sites is relevant to estimates of boiling fuel attack on gas-releasing sacrificial materials. (auth)

22316 (CRBRP-PMC-76-01) SAFETY AND ENVIRONMENTAL IMPACT OF LIQUID METAL FAST BREEDER REACTORS. Buhl, A. R.; Graham, J. (Clinch River Breeder Reactor Plant Project Office, Oak Ridge, Tenn. (USA)). Jan 1976. 14p. AT.

Liquid metal fast breeder reactors are a necessary component in the national energy program planned for introduction as commercial power generating stations in the mid-1980s. The safety and environmental impact of liquid fast breeder reactors is treated by considering principally the matters of most concern to the critics of the program in areas of safety and environmental impact. Areas of major concern, such as the use of sodium and its potential loss from the system as a coolant and the potential for critical reconfiguration accidents involving an energy release or damage to the core, are considered. Other areas of concern such as plutonium toxicity and the potential for inadvertent or malicious release of plutonium, waste management and waste heat rejection, and accidental releases of radioactivity are also covered. In each case, the situation is reviewed and the conclusion drawn that the LMFBR is a safe and environmentally attractive method of power generation. (auth)

22317 (ERDA-110(Vol. 3)) FEDERAL INVENTORY OF ENERGY RELATED BIOMEDICAL AND ENVIRONMENTAL RESEARCH FOR FY 1974 AND FY 1975. (Energy Research and Development Administration, Washington, D. C. (USA)). Oct 1975. vp. Dep. NTIS $13.60.

Brief summaries are presented of energy related biomedical and environmental research studies sponsored by the Environmental Protection Agency during 1974 and 1975. (CH)

22318 (EUR-5394e) EUROPEAN COMMUNITY LIGHT WATER REACTOR SAFETY RESEARCH PROJECTS, EXPERIMENTAL ISSUE. (Commission of the European Communities, Brussels (Belgium)). 1975. 559p. (In English and French). Dep. NTIS (US Sales Only) $13.50.

Brief summaries of LWR safety research projects conducted by members of the European community are presented. The research includes blowdown and emergency core cooling, core meltdown, external hazards, power transients, materials and mechanical problems, quality assurance, environmental protection, fuel cycle, and other areas. (JWR)

22319 (FRRSR-10) METROLOGY OF TWO-PHASE FLOW: DIFFERENT METHODS. Delhaye, J. M.; Galaup, J. P.; Reocreux, M.; Ricque, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). Sep 1973. Translation of CEA-R-4457. 114p. Dep. NTIS $5.50.

Nine papers are presented concerning different methods of measuring two-phase flow. Some of the methods and equipment discussed include: radiation absorption, electromagnetic flowmeter, anemometry, resistance probes, phase indicating microthermocouples, optical probes, sampling methods, and pitot tubes. (DCC)

22320 (GA-A-13617(Vol.3)) HTGR ACCIDENT INITIATION AND PROGRESSION ANALYSIS STATUS REPORT. Volume III. Preliminary Results (Including Design Options). (General Atomic Co., San Diego, Calif. (USA)). Nov 1975. Contract E(04-3)-167. vp. Dep. NTIS $7.60.

The results of a preliminary risk analysis, which was completed in February 1975, and represents the scoping phase of the AIPA program of the systematic probabilistic study of HTGR safety are presented. The preliminary phase was expected to provide several benefits: (1) establish a framework for the ranking of HTGR abnormal event sequences with respect to safety as an aid in the selection of future efforts, (2) provide quantitative data for the identification of R and D tasks, (3) provide bases for the selection of systems suitable for the studies of economic aspects of alternative design options for the safety-related systems, and (4) provide insights as to which aspects of the risk analysis need to be emphasized in the future to achieve necessary maturing of the probabilistic methodology. Seventeen initiating events were chosen and evaluated, these being representative of the complete spectrum of classes of potential radioactive sources in the plant and having potentially the highest probabilities of release within each class. While this ensured a considerable degree of completeness, it also resulted in evaluations of many events with insignificant risk, which are found in the text (e.g., an improbable event of release from a crushed small neutron source capsule). The most immediate application of preliminary analysis results was to determine which initiating events deserved a more detailed examination. (auth)

22321 (GEAP-14034-4) RADIOLOGICAL ASSESSMENT MODELS. Fourth Quarterly Report, June-August 1975. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1975. Contract E(04-3)-893. 53p. AT.

The objectives of the program described are to develop models for analyzing and evaluating postulated radiological sources, aerosol dynamics, sodium fires, and radiological dosages arising from hypothetical core disruptive accidents in liquid metal fast breeder reactors. The work performed during this reporting period continued the acquisition, review and evaluation of current technology, i.e., experimental data, analytical models, and computer codes, used in radiological modeling and assessment. In particular, a literature search was made to obtain experimental and theoretical information on fission product release from fuel and the chemical and physical state of fission products, a study was made to evaluate the sensitivity of changes in aerosol concentration to variations in the Stokes correction factor and gravitational collision efficiency at high aerosol concentrations, a review was made of the sodium fire computer codes, SPRAY, SOFIRE II and CACECO, a tabulation was made of various data such as dose conversion factors and organ clearance constants for use in dosage calculations, and a review was begun on atmospheric dispersion models. A preliminary model for analyzing the rapid expansion of saturated fuel out of the core was applied to a prototypic configuration. (auth)

22322 (HEDL-SA-9085) COMPUTATIONAL FEATURES OF THE MELT-III NEUTRONICS, THERMAL-HYDRAULICS COMPUTER CODE SYSTEM. Wilburn, N. P.; Waltar, A. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1976. 3p. (CONF-750607-41). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A multichannel, thermal-hydraulics, neutronic accident analysis program for simulating fast reactor behavior from a hypothetical accident inception to the start of core disassembly or to reactor shutdown is described. (JWR)

22323 (LA-UR-74-243) PROPOSAL FOR COMPUTER INVESTIGATION OF LMFBR CORE MELTDOWN ACCIDENTS. Boudreau, J. E.; Harlow, F. H.; Reed, W. H.; Barnes, J. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 59p. Dep. NTIS $4.50.

The environmental consequences of an LMFBR accident involving breach of containment are so severe that such accidents must not be allowed to happen. Present methods for analyzing hypothetical core disruptive accidents like a loss of flow with failure to scram cannot show conclusively that such accidents do not lead to a rupture of the pressure vessel. A major deficiency of present methods is their inability to follow large motions of a molten LMFBR core. Such motions may lead to a secondary supercritical configuration with a subsequent energy release that is sufficient to rupture the pressure vessel. The Los Alamos Scientific Laboratory proposes to develop a computer program for describing the dynamics of hypothetical accidents. This computer program will utilize implicit Eulerian fluid dynamics methods coupled with a time-dependent transport theory description of the neutronic behavior. This program will be capable of following core motions until a stable coolable configuration is reached. Survey calculations of reactor accidents with a variety of initiating events will be performed for reactors under current design to assess the safety of such reactors. (auth)

22324 (LA-UR-76-378) FAST REACTOR SAFETY EXPERIMENT NEEDS AND MEASUREMENT REQUIREMENTS. Stevenson, M. G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-Eng-36. 32p. (CONF-751141-5). Dep. NTIS $4.00.

From meeting on fuel and clad motion diagnostics in LMFBR safety test facilities; Albuquerque, New Mexico, USA (11 Nov 1975).

Key considerations in analysis of LMFBR core disruptive accidents are fuel pin and subassembly can integrity, permanent neutronic shutdown, primary system integrity, core material retention and cooling, and radioactive material transport and release. Technical problems in the accident analysis can be defined in four major areas: the initiating phase, the transition phase, accident energetics and consequences, and post accident heat removal. Experimental information needs in these areas are discussed. (DG)

22325 (LBL-4437) REVIEW OF THE AMERICAN PHYSICAL SOCIETY LIGHT WATER REACTOR SAFETY STUDY. Budnitz, R. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 4p. (CONF-751116-25). Dep. NTIS $3.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

The issue of light-water reactor (LWR) safety has been the subject of a part-time, year-long study sponsored by the American Physical Society and supported by the National Science Foundation and the former Atomic Energy Commission. The 1974-1975 study produced a Report by the Study Group to the Society. The Report's "Summary of Conclusions and Major Recommendations" section is presented. (auth)

22326 (ORNL/TM-5014(Vol.3)) COMPARISON BETWEEN DISPERSED NUCLEAR POWER PLANTS AND A NUCLEAR ENERGY CENTER AT A HYPOTHETICAL SITE ON KENTUCKY LAKE, TENNESSEE. Fitzpatrick, F. C.; Gray, D. D.; Hyndman, J. R.; Sisman, O.; Suffern, J. S.; Tyrrell, P. A.; West, D. C. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 121p. Dep. NTIS $7.00.

The thermal, ecological, and social impacts of a 40-reactor NEC are compared to impacts from four 10-reactor NECs and ten 4-reactor power plants. The comparison was made for surrogate sites in western Tennessee. The surrogate site for the 40-reactor NEC is located on Kentucky Lake. A layout is postulated for ten clusters of four reactors each with 2.5-mile spacing between clusters. The plants use natural-draft cooling towers. A transmission system is proposed for delivering the power (48,000 MW) to five load centers. Comparable transmission systems are proposed for the 10-reactor NECs and the 4-reactor dispersed sites delivering power to the same load centers. (auth)

22327 (UNI-SA-21) LECTURE NOTES: MEANTIME TO FAILURE ANALYSIS. Hanlen, R. C. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 23 Jan 1976. Contract AT(45-1)-1857. 12p. Dep. NTIS $3.50.

A method is presented which affects the Quality Assurance Engineer's place in management decision making by giving him a working parameter to base sound engineering and management decisions. The theory used in Reliability Engineering to determine the mean-time-to-failure of a component or system is reviewed. The method presented derives the probability density function for the parameter of the exponential distribution. The exponential distribution is commonly used by industry to determine the reliability of a component or system when the failure rate is assumed to be constant. Some examples of N Reactor performance data are used. To be specific: The ball system data with 4.9×10^6 unit hours of service and 7 individual failures indicates a demonstrated 98.8 percent reliability at a 95 percent confidence level for a 12 month mission period, and the diesel starts data with 7.2×10^5 unit hours of service and 1 failure indicates a demonstrated 94.4 percent reliability at a 95 percent confidence level for a 12 month mission period. (auth)

22328 (WCAP-8651) FLECHT LOW FLOODING RATE COSINE TEST SERIES DATA REPORT. Rosal, E. R.; Hochreiter, L. E.; McGuire, M. F.; Krepinevich, M. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1975. Contract AT(49-24)-0178. 498p. Dep. NTIS $12.50.

The FLECHT Low Flooding Rate Tests were conducted in an improved original FLECHT Test Facility to provide heat transfer coefficient and entrainment data at forced flooding rates of 1 in./sec and below. In addition these tests were performed to supplement parametric effects studied in the original FLECHT program, provide data for reflood model development, repeat original FLECHT tests with new instrumentation and data processing techniques, and to provide data to establish test repeatability. These tests examined the effects of low initial clad temperature, variable stepped and continuously variable flooding rates, housing heat release, run peak power, constant low flooding rates, coolant sub-cooling, hot and cold channel entrainment, and bundle stored and generated power. Data obtained in sixty-four runs which met the test specifications are reported, and include rod clad temperatures, turn around and quench times, heat transfer coefficients, inlet flooding rates, overall mass balances, differential pressures and calculated void fractions in the test section, thimble wall and and steam temperatures, exhaust steam and liquid carryover rates, and housing total and rate of heat release. (auth)

22329 CANDLE POWER AT BROWNS FERRY. Norman, C. Nature (London); 257: No. 5527, 525-526(16 Oct 1975).

An account is given of the serious accident that occurred to the Browns Ferry nuclear power station in Alabama on March 22, 1975, when a fire caused by an electrician searching for air leaks with a candle caused great damage to the reactor. The fire put several key safety systems out of action and caused problems in shutting down one of the plant's two reactors. The use of a candle for the purpose was regarded as a highly unofficial but time-honored method. In this case the candle ignited polyurethane foam surrounding some electrical cables, and the fire spread back through the reactor walls. Some alarming features of the fire fighting effort are noted. The use of water finally quickly extinguished the fire. The unconventional means that had to be adopted to shut down the reactors are described. Implications of the accident for other plants are being considered and modifications are suggested. There were no adverse effects on public health and safety. (UK)

22330 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN SEPTEMBER AND OCTOBER 1975. Casto, W. R. (comp.). Nucl. Saf.; 17: No. 1, 106-111(1976).

Included are discussions of the following occurrences: the transients caused by the Oconee-3 control system, the release of noble gases at Zion, and a feedwater line break at Quad Cities-2. (DG)

22331 TURBULENT DIFFUSION-TYPING SCHEMES: A REVIEW. Gifford, F. A. (National Oceanic and Atmospheric Administration, Oak Ridge, TN). Nucl. Saf.; 17: No. 1, 68-86(1976).

Recent environmental concerns have greatly increased the need for turbulent typing schemes in atmospheric diffusion calculations. The standard methods by Brookhaven National Laboratory, Pasquill, the Tennessee Valley Authority, and others are reviewed, and differences, inconsistencies, and modifications to the basic schemes are discussed. Various exceptional flows occur to which existing turbulence typing schemes should not be applied directly: diffusion in near-calm, very stable conditions; diffusion over cities, water bodies, and irregular terrain; and diffusion in building wakes and near highways. Possible modifications to typing schemes in these cases are discussed. In all such exceptional cases, many more observational data are needed before reliable diffusion estimates can be made. (auth)

22332 ANTICIPATED TRANSIENTS WITHOUT SCRAM: STATUS QUO. Hagen, E. W. (Oak Ridge National Lab., TN). Nucl. Saf.; 17: No. 1, 43-54(1976).

The purpose of Report WASH-1270 is to ensure a high degree of reliability for the plant safety systems of water-cooled nuclear power plants to protect the health and safety of the public. Implementation of the requirements set forth in the cover letter sent with that report to the power utilities has been proposed by the utilities, and reviews of these responses and analyses are under consideration by the Nuclear Regulatory Commission. Acceptance of the utilities' positions has not been granted, nor has further guidance or direction been proposed for power plants now operating or under construction. Future plants apparently will have to incorporate some as yet undefined design for a dual-acting plant safety system. (auth)

22333 PLANNING FOR NUCLEAR EMERGENCIES. Moeller, D. W. (Harvard Univ., Boston); Selby, J. M. Nucl. Saf.; 17: No. 1, 1-14(1976).

A properly developed and executed emergency plan represents an additional level of safety in dealing with potential accidents in nuclear facilities. A state-of-the-art review of the subject is presented which is based primarily on material presented by a variety of speakers during a short course held at the Harvard School of Public Health in May 1975. A certain degree of confusion has existed because of the multitude of federal and state agencies having responsibilities in this field; however, steps are being taken to correct this situation. Although updated Protective Action Guides for airborne releases have been published, similar action is needed for limitations on radionuclide intake via food and water. Indications are that, for a single puff type of airborne release, it may not be possible to evacuate the neighboring population within the short time span available to avoid exposure. For a longer term continuous type of airborne release, however, evacuation can be very useful. Still in need of further evaluation as an adjunct or alternative to evacuation is the use of protective shelter and/or radio-protective prophylaxis. Also in need of additional study and/or development are methods for assessing the nature and course of an accident, techniques for rapidly estimating the pathway of a release and anticipated population doses, assessment of

the long-range implications of potential widespread radioactive contamination of land areas, and improvements in the capabilities of state and local agencies in providing radiological emergency response. (auth)

22334 PARTIAL BLOCKAGES IN LMFBR FUEL ASSEMBLIES. Fontana, M. H. (Oak Ridge National Lab., TN). Nucl. Saf.; 17: No. 1, 19-32(1976).

Experimental and analytical data on the effects of partial blockages in simulated liquid-metal-cooled fast breeder reactor rod bundles are reviewed and the results presented. Experiments performed in the Fuel Failure Mockup at Oak Ridge National Laboratory with 13- and 24-subchannel inlet blockages in 19-rod sodium-cooled electrically heated rod bundles indicate that excessive temperatures do not occur as a result of the blockages. Similar experiments with nonheat-generating blockages of 6 central subchannels and 14 edge subchannels in the heated zone of the rod bundle indicate acceptable local temperature increases at operating conditions. Experiments with water mockups show complex flow patterns in the wake zone behind blockages. Estimates of local convective heat transfer in the wake zone were made by measuring mass interchange between the recirculating flow zone and the free stream by salt-injection techniques. Generalizations obtained from the water mockups were used to predict temperatures in sodium-cooled rod bundles. Estimates indicate that large blockages (approximately 3 in. in diameter) would be required to cause sodium boiling in full-scale reactors. (auth)

22335 EXPERIMENTAL INVESTIGATION OF SOME FURTHER ASPECTS OF THE BUOYANCY-DRIVEN EXCHANGE FLOW BETWEEN CARBON DIOXIDE AND AIR FOLLOWING A DEPRESSURIZATION ACCIDENT IN A MAGNOX REACTOR. II. The Purging Flow Requirements in Inclined Ducts. Mercer, A.; Thompson, H. (Safety in Mines Research Establishment, Sheffield, Eng.). J. Br. Nucl. Energy Soc.; 14: No. 4, 335-340(Oct 1975).

An experimental investigation of the purging flow requirements to prevent air ingress into the pressure vessel of a Magnox reactor following a depressurization accident is described. The cause of the accident is assumed to be a breach in one of the coolant ducts. Purging flow requirements in inclined ducts are considered. A $1/12$ scale simplified model using brine and water was used. The results are presented in non-dimensional form, and their application to the full-scale situation is discussed. (auth)

22336 EXPERIMENTAL INVESTIGATION OF SOME FURTHER ASPECTS OF THE BUOYANCY-DRIVEN EXCHANGE FLOW BETWEEN CARBON DIOXIDE AND AIR FOLLOWING A DEPRESSURIZATION ACCIDENT IN A MAGNOX REACTOR. I. The Exchange Flow in Inclined Ducts. Mercer, A.; Thompson, H. (Safety in Mines Research Establishment, Sheffield, Eng.). J. Br. Nucl. Energy Soc.; 14: No. 4, 327-334(Oct 1975).

The results of an experimental investigation into buoyancy-driven exchange flows in inclined and vertical ducts are presented. These flows could occur following a depressurization accident in a Magnox reactor. The experiments were carried out using a $1/12$ scale model with brine and water as the working fluids. It is shown that this model satisfied certain scaling criteria. A range of ratios of duct length to diameter and of inclinations of practical interest have also been investigated. The results are given in non-dimensional terms. (auth)

22337 DEVELOPMENT OF A COURSE IN WATER REACTOR SAFETY ANALYSIS. Layalka, S. K. (Univ. of Missouri, Columbia). Trans. Am. Nucl. Soc.; 22: 84(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22338 PLANNING A NUCLEAR PLANT PRIMARY SYSTEM DECONTAMINATION. Kiedaisch, W. I. (Commonwealth Edison Co., Chicago). Trans. Am. Nucl. Soc.; 22: 120-121(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22339 NUMERICAL SIMULATION OF FLOW IN AN UNWRAPPED DOWNCOMER. Butler, T. D.; Romero, N. C. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 260-261(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22340 DISCHARGE FLOW WITH TWO-DIMENSIONAL TWO-FLUID MODEL ANALYSIS. Hirt, C. W.; Rivard, W. C. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 261-263(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22341 THERMAL NONEQUILIBRIUM EFFECTS IN THE DRIFT FLUX MODEL OF TWO-PHASE FLOW. Ishii, M. (Argonne National Lab., IL); Jones, O.; Zuber, N. Trans. Am. Nucl. Soc.; 22: 263-264(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22342 SMALL-BREAK ANALYSIS MODELS IN THE RELAP4 COMPUTER CODE. Slater, C. E. (Intermountain Technologies, Idaho Fall, ID); Katsma, K. R.; Fischer, S. R.; Rettig, W. H. Trans. Am. Nucl. Soc.; 22: 264-265(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22343 SENSITIVITY TO PEAK CLADDING TEMPERATURE TO LOCA REFLOOD PARAMETERS. Oehlberg, R. N.; Scott, H. H. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 265-266(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22344 FUEL ROD BEHAVIOR DURING LOCA-ANALYSIS WITH FRAP-T. Dearien, J. A.; Siefken, L. J.; Broughton, J. M. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 266 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22345 BLOWDOWN ANALYSIS WITH EFFECTS OF ELBOWS AND VARIED FLOW AREA. Cheng, L. C.; Johnson, S. R. (General Atomic, San Diego, CA). Trans. Am. Nucl. Soc.; 22: 275-276(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22346 STABILITY ANALYSIS OF RELAP4 WITH SLIP. Lyczkowski, R. W. (Energy Inc., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 278-279(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22347 NUCLEAR ENERGY SITE STUDY. Smiley, S. H. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 302(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22348 SAFETY AND SECURITY OF NUCLEAR POWER REACTORS TO ACTS OF SABOTAGE. Kouts, H. J. C. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 342(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22349 WASTE MANAGEMENT SYSTEM FOR CANDU-PHW REACTORS. Drolet, T. S.; Choi, E. C.; Sovka, J. A. (Ontario Hydro, Toronto). Trans. Am. Nucl. Soc.; 22: 354(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22350 HOW SHOULD WASH-1400 RESULTS AND METHODOLOGY BE USED. Cramer, E. N. (Southern California Edison Co., Rosemead). Trans. Am. Nucl. Soc.; 22: 360-361(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22351 TECHNIQUE FOR DETERMINING HIGH-TRAJECTORY TURBINE MISSILE STRIKE PROBABILITY DISTRIBUTIONS. Campe, K. M.; Read, J. B. J. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 361-363(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22352 HAZARDS TO NUCLEAR PLANTS FROM OFF-SITE RELEASE OF TOXIC VAPORS. Hornyik, K. (Oregon State Univ., Corvallis). Trans. Am. Nucl. Soc.; 22: 363(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22353 INFORMATION THEORY AND NUCLEAR RISK. Bari, R. A. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 364-365(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22354 ACCOUNTING FOR WIND MEANDER AND SITE SHAPE IN PROBABILISTIC ATMOSPHERE DISPERSION MODELS. Woodard, K. (Pickard, Lowe and Associates, Inc., Washington, DC). Trans. Am. Nucl. Soc.; 22: 365-366(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22355 ANALYSIS OF TOP ACCIDENTS USING A CONSISTENT FCI MODEL FOR PREDISASSEMBLY AND DISASSEMBLY

PHASES. Froehlich, R. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.); Royl, P.; Schmuck, P.; Duesing, R.; Senglaub, M. Trans. Am. Nucl. Soc.; 22: 367-368(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22356 INFLUENCE OF EQUATION-OF-STATE UNCERTAINTIES ON FAST REACTOR DISASSEMBLY CALCULATIONS. Jackson, J. F.; Eaton, A. M.; Hall, R. M.; Bott, T. F. (Brigham Young Univ., Provo, UT). Trans. Am. Nucl. Soc.; 22: 368-370 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22357 PRESSURIZATION RATE EFFECTS IN IRRADIATED-CORE DISASSEMBLY CALCULATIONS. Jackson, J. F.; Eaton, A. M. (Brigham Young Univ., Provo, UT). Trans. Am. Nucl. Soc.; 22: 370-371(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22358 COMPARISON OF THREE DISASSEMBLY MODELS FOR A 1000-MW(e) FAST BREEDER REACTOR. Bleiweis, P. (Univ. of Illinois, Urbana); Ganapol, B.; Bowers, C.; Abramson, P.; Weber, D. Trans. Am. Nucl. Soc.; 22: 371-372(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22359 EFFECTS OF NEUTRON STREAMING AND GEOMETRIC MODELS ON MOLTEN-FUEL RECRITICALITY ACCIDENTS. McLaughlin, T. P. (Los Alamos Scientific Lab., NM). Trans. Am. Nucl. Soc.; 22: 372-373(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22360 MULTICHANNEL GROUPING TECHNIQUES FOR CONDUCTING REACTOR SAFETY STUDIES. Waltar, A. E.; Wilburn, N. P. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 375-376(Nov 1975).
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22361 CONSEQUENCES OF FUEL IMMOBILITY IN CRBRP OVERPOWER TRANSIENTS. Ginsberg, T. (Brookhaven National Lab., Upton, NY); Erdman, C. A. Trans. Am. Nucl. Soc.; 22: 376-377(Nov 1975).
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22362 FUEL FREEZING AND CHANNEL PLUGGING DURING FAST REACTOR OVERPOWER EXCURSIONS. Wong, K.; Dhir, V.; Kastenberg, W. E. (Univ. of California, Los Angeles). Trans. Am. Nucl. Soc.; 22: 377-378(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22363 PRELIMINARY ANALYSIS OF THE TRANSIENT OVERPOWER ACCIDENT FOR CRBRP WITH BOC 1 FUEL. Kastenberg, W. E.; Frank, M. V. (Univ. of California, Los Angeles). Trans. Am. Nucl. Soc.; 22: 378-379(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22364 COOLANT BOILING IN THE BEGINNING-OF-LIFE CORE DURING OVERPOWER EXCURSIONS. Kolesar, D. C. (Hanford Engineering and Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 379-381(Nov 1975).
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22365 TRANSIENT OVERPOWER ACCIDENT PHENOMENOLOGY IN THE GCFR. Frank, M. V.; Kastenberg, W. E. (Univ. of California, Los Angeles). Trans. Am. Nucl. Soc.; 22: 381(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22366 COMBINED DETERMINISTIC/PROBABILISTIC FAST REACTOR ACCIDENT ANALYSIS PROCEDURE. Fischer, G. J.; Bari, R. A.; Majumdar, D. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 381-383(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22367 BOILING FLOW REGIME MAPS IN LMFBR HCDA ANALYSIS. Fauske, H. K. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 385-386(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22368 BOILING FUEL-STEEL POOL CHARACTERISTICS IN LMFBR HCDA ANALYSIS. Fauske, H. K. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 386(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22369 MELTING OF STEEL STRUCTURE BY FLOWING FUEL OR STEEL VAPOR. Cho, D. H.; Epstein, M. (Argonne National Lab., Il). Trans. Am. Nucl. Soc.; 22: 386-387(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22370 MELTING ATTACK OF STEEL STRUCTURE BY A FLOW OF MOLTEN FUEL AND/OR STEEL. Epstein, M. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 387-389 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22371 TRANSIENT BEHAVIOR OF A VOLUME-HEATED BOILING POOL. Epstein, M. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 389(Nov 1975).
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22372 MODEL FOR THE MOLTEN-FUEL FLOW THROUGH THE FISSION GAS PLENUM PIN. Majumdar, D.; Hsu, C. J. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 389-390(Nov 1975).
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22373 NONEQUILIBRIUM EFFECTS IN VAPOR CONDENSATION ON ABOVE-CORE STEEL BLOCKAGE. Kazimi, M. S. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 390-391(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

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22463 FEASIBILITY OF USING RICHARDSON NUMBER FOR DETERMINING ATMOSPHERIC DISPERSION. Woodard, K. (Pickard, Lowe and Associates, Inc., Washington, DC). Trans. Am. Nucl. Soc.; 22: 508(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22464 SITE POPULATION EVALUATION. Kang, C. S.; Siu, R. P. (United Engineers and Constructors, Inc., Philadelphia). Trans. Am. Nucl. Soc.; 22: 511-512(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22465 NUCLEAR CRITIC'S COMMENTS ON CO-LOCATION OF NUCLEAR PLANTS AND NUCLEAR WASTE MANAGEMENT. Watt, B. E. (Sierra Club, San Francisco). Trans. Am. Nucl. Soc.; 22: 533(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22466 DOES ANYBODY KNOW WHAT TO DO WITH RADIOACTIVE WASTES. Lash, R. R. (Natural Resources Defense Council, Inc., Palo Alto, CA). Trans. Am. Nucl. Soc.; 22: 533-534(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22467 BWR LIQUID RADWASTE SYSTEM OPTIMIZATION STUDIES. Sumpter, J. R. (Houston Lighting and Power Co., TX); Granger, A. J.; Ayres, R.; Grant, T.; Haley, J. Trans. Am. Nucl. Soc.; 22: 542(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22468 EFFECT OF A SEISMIC DISTURBANCE ON CRBR CORE TEMPERATURES. Coffield, R.; Coldewey, R.; Eggers, A.; Nee, D. (Westinghouse Electric Corp., Madison, PA). Trans. Am. Nucl. Soc.; 22: 573-574(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22469 COMPARISON OF MEASURED AND CALCULATED RESPONSE OF EBR-II TO A LOSS-OF-FLOW TRANSIENT. Dean, E. M. (Argonne National Lab., Idaho Falls, ID); Gillette, J. L. Trans. Am. Nucl. Soc.; 22: 596(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22470 COBALT REDUCTION TECHNIQUES FOR CONSIDERATION IN LIGHT-WATER REACTOR DESIGNS. Potter, J. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 603-604(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22471 PRELIMINARY EVALUATION OF SENSOR TIME-RESPONSE TESTING. Trotter, J. D. (NUS Corp., Rockville, MD); Zimmerman, G. A. Trans. Am. Nucl. Soc.; 22: 616-617 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22472 PREOPERATIONAL ENVIRONMENTAL SURVEY: IS IT NECESSARY. Strodl, W. R. (Consumers Power Co., Jackson, MI). Trans. Am. Nucl. Soc.; 22: 628-630(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22473 ENVIRONMENTAL SURVEILLANCE AT THE ST. LUCIE POWER PLANT. Dunlop, D. D. (Florida Power and Light Co., Miami). Trans. Am. Nucl. Soc.; 22: 631(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22474 MEETING APPENDIX I AT OPERATING REACTORS. Lawroski, H. (Nuclear Services Corp., Campbell, CA). Trans. Am. Nucl. Soc.; 22: 631-632(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22475 ENVIRONMENTAL STUDY OF THE ECOLOGICAL EFFECTS OF THE THERMAL DISCHARGE FROM THE POINT BEACH NUCLEAR PLANT. Buss, D. F. (Limnetics, Inc., Milwaukee). Trans. Am. Nucl. Soc.; 22: 640(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22476 REAL-TIME OPERATING PLANT METEOROLOGICAL DATA PROCESSING AND DOSE ASSESSMENT USING A MINICOMPUTER. Woodard, K. (Pickard, Lowe and Associates, Inc., Washington, DC); Potter, T.; Celi, T. Trans. Am. Nucl. Soc.; 22: 640-641(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22477 PRACTICAL LIQUID RADWASTE EFFLUENT ANALYSIS, RECORDKEEPING, AND REPORTING. Walker, D. M. (Applied Physical Tech., Atlanta); Smith, D.; Harrison, J. L. Trans. Am. Nucl. Soc.; 22: 642(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22478 CHARACTERIZATION OF IRRADIATED FUEL RODS USING PULSED EDDY-CURRENT TECHNIQUES. Martin, M. R.; Francis, W. C. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 766-768(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22479 CALCULATION OF ACCIDENT DOSES TO EQUIPMENT INSIDE CONTAINMENT IN POWER REACTORS. Kolar, M. J.; Olson, N. C. (Commonwealth Associates, Inc., Jackson, MI). Trans. Am. Nucl. Soc.; 22: 808-809(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22480 SUBCOMPARTMENT ANALYSIS OF HIGH-ENERGY PIPE RUPTURES. Savery, C. W. (Drexel Univ., Philadelphia); Huang, Y. S.; Kowal, G. M. Nucl. Technol.; 27: No. 3, 327-336 (Nov 1975).
A computer code, MNODE, for predicting the state histories and inventories of an inert gas and water liquid and vapor flowing in a zoned containment has been developed. It employs a model that describes the unsteady flow and thermodynamics of two-phase two-component mixtures flowing among 12 connected control volumes. This calculational model can be applied to problems of hypothetical high-pressure primary coolant, feed water, or steam line ruptures in such structures as nuclear containments, tunnels, or auxiliary buildings. In comparison with previously reported zoned containment computation models, this model rigorously treats the thermodynamics of two-phase two-component mixtures of water and an inert gas, is provided with several flow model options including an inertia flow equation, and is demonstrated with substantial verification. (auth)

Reactor Theory and Calculation

Refer also to abstracts 21550, 21706, and 22330.

22481 (ANL-8010) APPLIED PHYSICS DIVISION ANNUAL REPORT, JULY 1, 1971–JUNE 30, 1972. (Argonne National Lab., Ill. (USA)). 1972. Contract W-31-109-Eng-38. 615p. AT.
Separate abstracts are presented for four major sections concerning fission properties and cross-section data, fast reactor physics, experimental techniques and facilities, and reactor computation methods and theory. (DCC)

For abstracts of individual sections see: 21697, 22085, 22482, and 22517.

22482 (ANL-8010, pp 464-587) REACTOR COMPUTATION METHODS AND THEORY. 1972.
In applied physics division annual report, July 1, 1971–June 30, 1972. (Argonne National Lab., Ill. (USA)).
To a large degree, the quality of reactor design and performance depends upon the quality of the conceptual models, their portrayal in accurate mathematical representation, and the quality and efficiency of computational methods. A priori, the continuous development and refinement of theory and computational methods lead to the design of more dependable, safer, and better-performing reactors. It is with this intent that the studies described in this section were undertaken. (auth)

22483 (CONF-750117–P2, pp 1065-1092) GENERALIZED FINITE DIFFERENCE METHOD OF SPACE–TIME REACTOR DYNAMICS CALCULATION IN TWO DIMENSIONS. Yeh, K. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). 1975.
From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).
In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).
An application of the Generalized Finite Difference Method to two-dimensional multigroup reactor dynamics problems has been made. Trial solutions at node points, which are connected by polynomials, can be arbitrarily proposed and then improved by correcting factors through the use of variational principles.

The method for the construction of trial solutions over subregions has been developed to overcome the difficulty of material discontinuity at spatial interfaces. The static shape function for a given reactor configuration and/or quasistatic shape functions at chosen times of reactor dynamics problems can be calculated. Successful numerical experiments have been made with results comparable to those obtained through other techniques. (auth)

22484 GROUPWISE REBALANCING TECHNIQUE FOR INTEGRAL TRANSPORT PROBLEMS. Cheng, H. S. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 244-245 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22485 OPTIMIZED ITERATION STRATEGIES FOR FAST REACTOR FINITE-DIFFERENCE DIFFUSION THEORY CODES. Ferguson, D. R. (Argonne National Lab., IL); Derstine, K. L.; Borg, R. C.; Daly, T. A. Trans. Am. Nucl. Soc.; 22: 245-246 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22486 ACCELERATION TECHNIQUES FOR RESPONSE MATRIX METHODS. Sicilian, J. M.; Pryor, R. J. (Savannah River Lab., Aiken, SC). Trans. Am. Nucl. Soc.; 22: 246-248 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22487 SOLUTION OF THE DIFFUSION OF P_1 FINITE ELEMENT EQUATIONS BY ITERATION. Tomlinson, E. T. (Univ. of Tennessee, Knoxville); Robinson, J. C.; Vondy, D. R. Trans. Am. Nucl. Soc.; 22: 248(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22488 DETERMINATION OF DIFFUSION PARAMETERS USING RESPONSE MATRIX THEORY. Pryor, R. J.; Sicilian, J. M. (Savannah River Lab., Aiken, SC). Trans. Am. Nucl. Soc.; 22: 249-250(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22489 HIGHER ORDER CORRECTIONS IN NODAL REACTOR CALCULATIONS. Bennewitz, F.; Finnemann, H.; Wagner, M. R. (Kraftwerk Union A.G., Erlangen, Germany). Trans. Am. Nucl. Soc.; 22: 250-251(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22490 CONVERGENCE OF THE FINITE ELEMENT METHOD IN NEUTRON TRANSPORT. Martin, W. R. (Univ. of Michigan, Ann Arbor). Trans. Am. Nucl. Soc.; 22: 251-252(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22491 TWO-GROUP TRANSPORT CALCULATIONS WITH LINEARLY ANISOTROPIC SCATTERING. Jorge, E.; Ishiguro, Y. (Cidade Univ., Sao Paulo, Brazil). Trans. Am. Nucl. Soc.; 22: 253(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22492 ANALYTIC SOLUTION OF THE MONOENERGETIC TIME-DEPENDENT ALBEDO PROBLEM. Ganapol, B. D. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 255-256(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22493 ONE MORE ALGORITHM FOR GENERATING ELASTIC AND INELASTIC SCATTERING MATRICES. Grimesey, R. A. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 256-257(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22494 REPLACEMENT OF REFLECTORS BY ANALYTICALLY DERIVED BOUNDARY CONDITIONS. Kalambokas, P. C.; Henry, A. F. (Massachusetts Inst. of Tech., Cambridge). Trans. Am. Nucl. Soc.; 22: 257(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22495 EFFECT OF VOID STREAMING ON FLUX SHAPES NEAR VACUUM BOUNDARIES. Gelbard, E. M. (Argonne National Lab., IL); Lell, R. Trans. Am. Nucl. Soc.; 22: 257-258(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22496 INVARIANT IMBEDDING ANALYSIS OF PARTICLE TRANSPORT INCORPORATING ORDERS-OF-SCATTERING. Woolf, S. (Arcon Corp., Wakefield, MA); Garth, J. C.; Filippone, W. L. Trans. Am. Nucl. Soc.; 22: 258-259(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22497 COLUMN SEPARATION TREATMENT OF CAVITATION FOR PRESSURE TRANSIENT ANALYSES. Kot, C. A.; Youngdahl, C. K. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 273(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22498 TWO-DIMENSIONAL FLUID-HAMMER PROBLEMS BY THE METHOD OF NEAR CHARACTERISTICS. Shin, Y. W.; Kot, C. A. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 273-275(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22499 ADJOINT SOLUTION OF THE LINEAR INVERSE HEAT CONDUCTION PROBLEM. Agee, L. J. (Combustion Engineering, Inc., Windsor, CT). Trans. Am. Nucl. Soc.; 22: 276-277(Nov 1975)
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22500 LINEARIZATION OF THE NONLINEAR INVERSE HEAT CONDUCTION PROBLEM. Agee, L. J. (Combustion Engineering, Inc., Windsor, CT). Trans. Am. Nucl. Soc.; 22: 277-278(Nov 1975)
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22501 POISON DISTRIBUTION RESULTING IN A DESIRED POWER DISTRIBUTION. Tzanos, C. P. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 327-328(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22502 PARAMETRIC STUDIES CONCERNING ACTINIDE TRANSMUTATION IN POWER REACTORS. Croff, A. G. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 345-346 (Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22503 AXIAL PRESSURE VARIATIONS OF TWO PARALLEL FLOWS COMMUNICATING BY A SLOT. Tapucu, A. (Institut de Genie Nucleaire, Montreal). Trans. Am. Nucl. Soc.; 22: 583-584(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22504 FLOW REDISTRIBUTION IN THE VICINITY OF A COLLAPSED FUEL ROD. Massey, J. V.; Carlson, R. W. (Georgia Inst. of Tech., Atlanta). Trans. Am. Nucl. Soc.; 22: 587(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22505 VALIDATION RESULTS FOR THE SDX CELL HOMOGENIZATION CODE. Wade, D. C. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 655-657(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22506 DECAY-HEAT UNCERTAINTIES. Schmittroth, F.; Schenter, R. E. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 675-676(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22507 EFFECT OF NEUTRON CAPTURE ON DECAY HEAT FROM ^{235}U. Holm, J. S.; Shay, M. R.; Spinrad, B. I. (Oregon State Univ., Corvallis). Trans. Am. Nucl. Soc.; 22: 676(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22508 BENCHMARK NUCLEAR DOPPLER MEASUREMENTS USING A HYBRID STATIC/DYNAMIC HEATING TECHNIQUE. Russell, G. J. (Los Alamos Scientific Lab., NM); Foell, W. K. Trans. Am. Nucl. Soc.; 22: 687(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22509 TWO-DETECTOR REACTIVITY MONITOR UTILIZING ION CHAMBERS. Lung, T. P.; Ruby, L. (Univ. of California, Berkeley). Trans. Am. Nucl. Soc.; 22: 690-691(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22510 SYNBURN: A FAST REACTOR FUEL CYCLE CODE. Pizzica, P. A. (Argonne National Lab., IL); Meneley, D. A. Trans. Am. Nucl. Soc.; 22: 701-702(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22511 NEUTRON THERMALIZATION IN H_2O: MEASUREMENT AND CALCULATION OF SPECTRA. Abbate, M. J. (Centro Atomico Bariloche, Argentina); Lolich, J. V.; Parkinson, T. F. *Trans. Am. Nucl. Soc.; 22: 709(Nov 1975).*
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22512 GENERALIZED DISPERSION THEORY FOR BOUNDED FAST ASSEMBLIES. Kraft, T.; Dorning, J. (Univ. of Illinois, Urbana). Trans. Am. Nucl. Soc.; 22: 709-711(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22513 ANALYSIS OF MIXED-OXIDE-FUELED CRITICAL EXPERIMENTS USING ENDF/B-IV DATA. Cheng, H. S. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 720-722(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22514 ENVIRONMENTAL DOSE PROFILES FROM ^{16}N PHOTONS NEAR LARGE BWRS. Lowder, W. M.; Raft, P. D.; Boyle, M. (Health and Safety Lab., New York). Trans. Am. Nucl. Soc.; 22: 801-802(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22515 ANALYSIS OF THE MICROFISSION REACTOR CONCEPT. Cole, R. K. Jr.; Renken, J. H. (Sandia Labs., Albuquerque, NM). Nucl. Sci. Eng.; 58: No. 4, 345-353(Dec 1975).
There is current interest in the possibility that symmetric irradiation of a small pellet of fissionable material by intense laser beams may produce sufficient compression to cause the pellet to become supercritical and thus produce a fission microexplosion. It has been proposed that a repetitive series of such explosions in a suitable chamber could be the basis for an alternative means of generating commercial power from nuclear energy. An analysis of this scheme is presented that shows that the energetics do not appear favorable for power generation purposes. Although an input of several hundred megajoules of radiation energy is necessary to trigger a microexplosion, the idea appears to be an interesting physics experiment. Such microexplosions would be unique short-duration sources of nuclear radiations. (auth)

Reactor Components and Accessories

Refer also to abstracts 20279, 20280, 22313, 22330, 22440, 22443–22445, and 22583.

22516 (AEEW-M-1361) PROPOSED SUPERSCREENED CABLES AND CONNECTORS. Fowler, E. P. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Nov 1975. 16p. Dep. NTIS (US Sales Only) $3.50.
The present availability of superscreened cables is described. The specification of a family of cables to meet the foreseeable needs of the nuclear power industry is proposed. The cable numbering system is described, special tests outlined and important details given for the chosen cables. Appropriate connectors are also discussed and listed with an outline of their required screening performance. (auth)

22517 (ANL-8010, pp 331-461) EXPERIMENTAL TECHNIQUES AND FACILITIES. 1972.
In Applied Physics Division annual report, July 1, 1971–June 30, 1972. (Argonne National Lab., Ill. (USA)).
Measured integral reactor physics parameters are necessary for either direct introduction into reactor design calculations or for comparison with values obtained analytically using basic microscopic cross-section data. In the latter case, the objective is to certify either the cross-section data or the calculational techniques. Reactor integral parameters are obtained using special measurement techniques in exponential or critical facilities. The development of such special techniques, facilities, and radiation-detection devices is reviewed. Specially developed equipment useful in obtaining microscopic nuclear data is described. (auth)

22518 (CONF-750117-P1, pp 353-370) FLOW-INDUCED VIBRATIONS OF REACTOR INTERNAL AND PLANT COMPONENTS. Chen, S. S. (Argonne National Lab., IL). 1975.
From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).
In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).
The current literature on flow induced vibrations in reactors is summarized. Several types of vibrations are discussed and methods of analysis for each type are described. General design guidelines for minimizing vibration problems are also discussed. *(JWR)*

22519 (EUR-5395(Vol.1)) INTERNATIONAL COLLOQUIUM ON HIGH-TEMPERATURE IN-PILE THERMOMETRY HELD AT J.R.C., PETTEN, NETHERLANDS, DECEMBER 12–13, 1974. von der Hardt, P.; Zeisser, P.; Mason, F. (eds.). (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment). 1975. 439p. (In French and English). CONF-741226-P1). Commission of the European Communities, Luxembourg.
From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).
Included are nineteen papers dealing with fabrication, design, and performance of thermocouples for high temperature applications. Separate abstracts and indexing were prepared for each paper. (DG)

For abstracts of individual papers see: 22090 and 22520–22537.

22520 (EUR-5395(Vol.1), pp 1-23) HIGHLY STABLE, SHEATHED, BERYLLIA INSULATED, TUNGSTEN-RHENIUM ALLOY THERMOCOUPLES. Burns, G. W.; Hurst, W. S. (National Bureau of Standards, Washington, DC). 1975.
From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).
In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).
The fabrication and performance testing of 1.6 mm diameter tantalum sheathed, beryllium oxide (BeO) insulated, W-3 percent Re/W-25 percent Re thermocouples are reported. Fully assembled thermocouples constructed from aged thermoelements, specially heat treated, sintered BeO insulators, and specially cleaned and etched tantalum sheaths were tested for 2059 h at 1800^{0}C in a helium environment. The measured thermal emf drifts were less than the equivalent of 1^{0}C per thousand hours of exposure at 1800^{0}C. No gross chemical attack or degradation of the component materials was evident. The fabrication techniques, thermal emf test results, and post-test analyses of the component materials are discussed. (auth)

22521 (EUR-5395(Vol.1), pp 25-59) PRODUCTION OF REACTOR GRADE HIGH TEMPERATURE THERMOCOUPLES AT AERE HARWELL. Evans, J. P.; Nayler, S. I.; Steer, C. (AERE, Harwell, Eng.). 1975.
From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).
In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).
A discussion is presented of the specification adopted for the Harwell thermocouples, the type of construction, basic method of manufacture and subsequent inspection and tests. (auth)

22522 (EUR-5395(Vol.1), pp 61-71) MANUFACTURING HIGH TEMPERATURE THERMOCOUPLES. Coville, P. (SODERN, SA, Suresnes, France). 1975.
From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).
In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment.
A discussion is presented of welding techniques and cleaning processes used in thermocouple fabrication. (DG)

22523 (EUR-5395(Vol.1), pp 73-88) HIGH-TEMPERATURE STRANDED TUNGSTEN-RHENIUM THERMOCOUPLES. Ward, D. L.; Cornock, H. (AERE, Harwell, Eng.). 1975.
From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).
In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).
A description is presented of a stranded tungsten-rhenium

thermocouple, encapsulated in twin-bore alumina tube, that has been developed at Harwell. Special techniques were developed making it possible to melt hard fired alumina tube and encapsulate the hot junction, thus eliminating the need for a refractory-metal protective sheath. The conductor wires are supported but unconstrained. Tests are described, starting with the search for a sound hot junction and leading to the successful operation in-pile of a 3-metre long thermocouple unit. (auth)

22524 (EUR-5395(Vol.1), pp 89-122) COMPOSITE THERMOCOUPLES. Debeir, R. P. (CCR, Ispra, Italy). 1975. (In French)

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

As a general rule, a composite thermocouple is a thermocouple where one or more components: wires, sheath, insulation differ in kind between the hot junction measurement point and the cold termination with ordinary cables going on to measurement instrumentation. A description is presented of the design, application, and testing of three types of composite thermocouple. (auth)

22525 (EUR-5395(Vol.1), pp 126-155) MANUFACTURE, INSPECTION: AND UTILIZATION IN-PILE OF "HIGH TEMPERATURE" THERMOCOUPLES. Schley, R.; Liermann, J. 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

For several years, the CEA has continued with its efforts to improve the reliability of the high temperature thermocouples used in irradiation devices. Studies made in France and elsewhere have shown the harmful effect of impurities on the behaviour of thermocouples in-pile. For this reason only components of high purity assembled in very clean conditions are used. The systematic study of the reasons for poor performance has permitted improvements in the design of the thermocouples and also in the assembly and production inspection methods. (auth)

22526 (EUR-5395(Vol.1), pp 156-161) FABRICATION OF HT-SHEATHED THERMOCOUPLES. Poniatowski, M.; Vael, G. 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The measurement of central temperatures in fuel-elements of nuclear reactors requires special thermocouples with high standards in fabrication due to the need to operate in high temperature and neutron flux. The detectors are constructed as sheathed thermocouples. The components consist of high temperature materials such as W-Re-alloys for the thermoelements. Niob and Tantal for the sheath, and BeO for the insulation. Specifications regarding the use were formulated in collaboration with Euratom Petten. Based on this specification the Department, Research Metall, of Degussa developed a fabrication technique for high temperature thermocouples. (auth)

22527 (EUR-5395(Vol.1), pp 163-188) W-5%Re/W-26%Re THERMOCOUPLES FOR MEASUREMENT OF HIGH TEMPERATURE: FABRICATION AND PROPERTIES. Jacquin, B. 1975. (In French).

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A description is given of the mechanical, physical, and thermoelectric properties of elements manufactured with either the W-WRe 26% or with the WRe 5% - WRe 26% combination. The mechanical properties of the WRe 5% are superior to those of the pure Tungsten with respect to breaking-resistance, fragility, and elasticity. Experience has shown that the W-Re 26% thermocouples have a strong tendency to degrade with the passage of time. (auth)

22528 (EUR-5395(Vol.1), pp 189-201) BEHAVIOUR OF Pt/Pt-13% Rh THERMOCOUPLES IN A HIGH TEMPERATURE FUEL IRRADIATED EXPERIMENT. Bauchede, J. (CEN, Saclay, France); Haange, R. 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Pt/Pt-13% Rh thermocouples have operated reliably in the Colibri HTR 4 rig for 50 days at 1300°C, for 80 days at 1200°C, and for 150 days at 500 to 1200°C and are continuing to operate satisfactorily. Within the limits of measurement relevant to the experiment there was no discernible change in thermoelectric output of the thermocouples. (auth)

22529 (EUR-5395(Vol.1), pp 203-236) DRIFT AND LIFE OF SELECTED HIGH TEMPERATURE THERMOCOUPLES IN A JOINT AERE HARWELL, J.R.C. PETTEN IRRADIATION EXPERIMENT. Mason, F. 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A description is given of the design and operation of a joint AERE Harwell/J.R.C. Petten irradiation experiment, which is currently being irradiated in the H.F.R. at Petten. The assembly can accommodate a variety of up to twenty-eight thermocouples, and can operate at a temperature of about 1500°C, under the influence of nuclear heating only. The operational performance is reviewed, as are the apparent trends, which have been observed, during the first ninety-five days of irradiation. The thermal dose received by the thermocouple units in this time is about 1.3×10^{21} n cm^{-2}. Provision is also made in the assembly to introduce up to two new thermocouple units, at convenient reactor shutdowns, to enable the extent of the thermocouple drift to be estimated. One was installed after fifty-seven days of operation, and the second one will be installed after ninety-five days of operation. (auth)

22530 (EUR-5395(Vol.1), pp 237-268) CORRECTION OF IRRADIATION-PRODUCED DRIFT IN W-Re FUEL CENTERLINE THERMOCOUPLES. Shepard, R. L.; Kollie, T. G. 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The calibration drift occurring in W-Re fuel centerline thermocouples in an in-pile experiment can be determined quantitatively during irradiation and corrected for by measuring both the thermocouple output and the electrical resistance of the thermocouple loop and applying Matthiesen's rule to interpret the results. The temperature error in a particular experiment is strongly affected by the temperature gradient along the thermocouple. Some generalizations can be made about the effects of irradiation temperature and neutron flux on thermocouple drift rate, however, variations in temperature gradient among experiments preclude direct comparisons and make post-irradiation calibration difficult to interpret. These complications require the development of an on-line method for drift correction. A description is given of such a method. (auth)

22531 (EUR-5395(Vol.1), pp 269-281) TRAVELLING GRADIENT THERMOCOUPLE CALIBRATION. Broomfield, G. H. (AERE, Harwell, Eng.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A short discussion of the origins of the thermocouple EMF is used to re-introduce the idea that the Peltier and Thompson effects are indistinguishable from one another. Thermocouples may be viewed as devices which generate an EMF at junctions or as integrators of EMF's developed in thermal gradients. The thermal gradient view is considered the more appropriate because of its better accord with theory and behaviour. Inhomogeneities arise in thermocouples during manufacture and in service. The results of travelling gradient measurements are used to show that such effects are revealed with a resolution which depends on the length of the gradient although they may be masked during simple immersion calibration. Proposed tests on thermocouples irradiated in a nuclear reactor are discussed. (auth)

22532 (EUR-5395(Vol.1), pp 283-310) INVESTIGATION ON MATERIAL-COMPATIBILITY AND PROTECTIVE COATING FOR

HIGH TEMPERATURE THERMOCOUPLES. Haas, H.; Gerken, W.; Delis, K.; Schmidt, F. 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Many reactor experiments fail or else run without exact control because of premature failing of high temperature thermocouples. Corrosion of the sheath with the resulting destruction of the hot junction are frequent causes of the failing. Incompatibility of the thermocouple materials and also reactions with the gases and structural material surrounding the thermocouples can cause severe corrosion, and lead to subsequent failure. Some out-of-pile corrosion and compatibility experiments are described which were carried out on thermocouple dummies under vacuum and in polluted helium. The impurities contain oxidizing and reducing ingredients. These tests deal with the compatibility of different thermocouple structural materials and especially with protective coatings which prevent metallurgical interactions with the environment. It is shown that it is possible to provide an effective protection of the thermocouple to corrosion attack even under most unfavorable conditions. The experiments also show that the materials of current high temperature thermocouples are compatible at least up to 1700°C. (auth)

22533 (EUR-5395(Vol.1), pp 311-324) OBJECT: CONSEQUENCES OF IRRADIATION OF THE CALIBRATION OF W-Re THERMOCOUPLES. Schley, R.; Matteudi, G.; Bazin, J. (CEN, Saclay, France). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Thermocouples provided for measuring in-pile temperature are exposed to a neutron flux which alters their characteristics. The influences of fast neutrons (energy > MeV) and of thermal neutrons are examined experimentally and theoretically. (auth)

22534 (EUR-5395(Vol.1), pp 325-342a) NEW THERMOCOUPLES FOR THE MEASUREMENT OF TEMPERATURES ABOVE 1000°C. Schley, R.; Liermann, J.; Metauer, G.; Gentil, J. (CEN, Saclay, France). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

An investigation of the Mo/Nb thermocouple is presented under the following headings: study of the e.m.f, influences of recrystallization, study of the influence on the e.m.f of adding Mo to the negative leg, and study of the compensation wires between 0°C and 300°C. (auth)

22535 (EUR-5395(Vol.1), pp 343-362) COMPATIBILITY WITH GRAPHITE, OF HIGH TEMPERATURE THERMOCOUPLES SHEATHED WITH VARIOUS REFRACTORY METALS AND ALLOYS. Schley, R.; Metauer, G.; Gentil, J. (CEN, Saclay, France). 1975. (In French and English)

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A study is presented of the compatibility at 1200°C and 1660°C of Niobium, Molybdenum, and Rhenium with graphite. These three sheath materials are generally used to protect the W/Re thermocouple wires. It is demonstrated that it is possible to extend the operating temperature of Type K thermocouples to about 1250°C in a graphite environment by using a sheath material normally used in the industrial fabrication of Type K thermocouples (e.g., Inconel). (auth)

22536 (EUR-5395(Vol.1), pp 363-375) PREPARATION AND CALIBRATION OF W-5% Re v. W-26% Re THERMOCOUPLES FOR IRRADIATION IN H.F.R. PETTEN. Evans, J. P.; Mardon, P. G. 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The decalibration of W/Re thermocouples under neutron irradiation has been studied at Petten in a collaborative experiment. The experiment was designed to separate the effects of transmutation from those of displacement damage by running at temperatures (~1500°C) high enough for the displacement damage to anneal out. A description is given of the methods and conditions of manufacture of some of the thermocouples and also the calibration techniques used. Travelling gradient calibration was used to identify the position of inhomogeneities in the wires before irradiation and will be compared with similar data after irradiation. (auth)

22537 (EUR-5395(Vol.1), pp 377-411) DRIFT OF SHEATHED CHROMEL/ALUMEL THERMOCOUPLES ASSOCIATED WITH CORROSION OF SENSITIVE WIRES BY DIFFUSED AIR. Mathieu, F.; Meier, R.; Vanmassenhove, G.; Delcon, M.; De Deyne, A. (CEN/SCK, Mol, Belgium). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Investigation methods that have been developed in recent years for dealing with problems on thermocouple drift are reviewed. Basic ideas are documented with selected experimental data concerning the thermoelectric behavior of sheathed chromel/alumel thermocouples resulting from corrosion by diffused air. An explanation is in particular given why drift magnitudes ranging from high positive to significant negative values can be found for a given damaged thermocouple. It appears furthermore that important errors can result from corrosion by air diffusing into the sheaths at the cold ends when they are not adequately sealed. A short appendix is devoted to a BR2 thermocouple irradiation rig. (auth)

22538 (EUR-5395(Vol.2), pp 585-615) RADIATION INDUCED E.M.F. DEVELOPING IN THE INSULATION OF METAL SHEATHED MINERAL INSULATED HIGH TEMPERATURE THERMOCOUPLES AND ITS EFFECTS OF THE THERMOCOUPLE SIGNAL. Tarassenko, S. (AEE, Winfrith, Eng.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The behaviour and performance of tungsten-rhenium thermocouple instrumentation in DRAGON reactor irradiation experiments is briefly reviewed. A particular emphasis is put on the existence and origin of EMF signals induced within the insulant of such thermocouples and distributed along the "hot zone" part of the thermoelectric circuit. It is shown how a thermocouple failure caused by a hardly detectable open circuit can result in a misleading interpretation of the temperature reading, with the inherent consequences regarding the reactor operation. (auth)

22539 (EUR-5395(Vol.2)) INTERNATIONAL COLLOQUIUM ON HIGH-TEMPERATURE IN-PILE THERMOMETRY HELD AT J.R.C., Petten, Netherlands, December 12-13, 1974. von der Hardt, P.; Zeisser, P.; Mason, F. (eds.). (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment). 1975. 407p. (In several languages). (CONF-741226-P2). Commission of the European Communities, Luxembourg.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

Included are nineteen papers dealing with thermocouples and ultrasonic and noise thermometry. Separate abstracts and indexing were prepared for eighteen papers. (DG)

For abstracts of individual papers see: 22040, 22041, 22076, 22218, 22297, 22538, 22540-22550, and 22583.

22540 (EUR-5395(Vol.2), pp 429-459) UTILIZATION OF W-Re(5% Re; 26% Re) THERMOCOUPLES IN STUDIES OF NUCLEAR FUELS. Combette, P.; Faugere, J. L.; Schley, R.; Stora, J. P.; Lucot, M.; Lierman, J.; Gentil, J.; Aujollet, J. P. (CEN, Fontenay-aux-Roses, France). 1975. (In French)

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A description is given of the technology of thermocouples which are used with U and Pu fuel. The installation of the thermocouple unit in the fuel pin is also described. Data are presented which show that by using W-Re thermocouples, distinct trends of the sintering and swelling phenomena in fuel pins consisting of a mixture of U and Pu carbides can be identified. Analysis of a number of results obtained in the CEA permits an estimation of the probable lifetime of a thermocouple in a given set of conditions. (auth)

22541 (EUR-5395(Vol.2), pp 461-475) IN-PILE EXPERIENCES OF HIGH TEMPERATURE MEASUREMENTS AT RISOE. Fayl, G.; Hansen, K.; Johansen, B.S. (Danish Atomic Energy Commission, Research Establishment, Risoe). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

In order to study the influences of design and operational parameters on fuel pin thermal behaviour, three types of irradiation rigs equipped with thermocouples have been developed. UO_2 pellets with diameters ranging from 12.5 to 17.5 mm and stack lengths from 80 to 500 mm have been irradiated at fuel temperatures up to 2350°C. Fuel temperatures have been measured in up to three different radial positions by means of refractory metal thermocouples. Results were obtained at different flux levels for irradiation times up to 740 days and 86 reactor shut-downs. A system developed to exchange the irradiated thermocouple in the fuel centre is applicable up to a maximum fuel temperature of approximately 1400°C. (auth)

22542 (EUR-5395(Vol.2), pp 533-550) EXPERIENCE OBTAINED WITH HIGH-TEMPERATURE THERMOCOUPLES IN IRRADIATION EXPERIMENTS. Lehning, H.; Haefner, H. E. (GfK, Karlsruhe, Ger.). 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Experience obtained during assembly and operation is discussed together with questions relating to construction, evaluation of measured results, and rates of failure. (auth)

22543 (EUR-5395(Vol.2), pp 579-584) TUNGSTEN RHENIUM THERMOCOUPLE DRIFT UNDER IRRADIATION. Johnson, F. A.; Walter, A. J.; Brooks, R. H. (AERE, Harwell, Eng.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Results are presented which indicate the changes in calibration with irradiation history for W.26%Re/W.5%Re thermocouples. It is shown that for a given thermocouple the percentage change is reasonably constant over the 800-1400°C region but that there is significant variation between the behavior of thermocouples which have nominally the same irradiation and temperature cycling histories. (auth)

22544 (EUR-5395(Vol.2), pp 617-621) TEMPERATURE MEASUREMENT OF ZIRCALOY CLAD FUEL PINS DURING HIGH TEMPERATURE EXCURSIONS. Meservey, R. H. (Aerojet Nuclear Co., Idaho Falls, ID). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Reliable thermocouples can be made for use on Zircaloy clad fuel pins during high temperature excursions such as encountered during blowdown type safety tests. The thermocouples can be laser welded to the fuel pin cladding in such a manner as to provide temperature data through many thousands of hours of reactor operations, and through many high temperature cycles. Recent advances in the tubing manufacturing industry have made Zircaloy tubing of the required dimensions available. Preliminary tests indicate that similar thermocouples using Zircaloy sheaths will improve the lifetime of the fuel clad thermocouples. (auth)

22545 (EUR-5395(Vol.2), pp 649-680) ULTRASONIC THERMOMETER USING A RESONANT SENSOR. Bell, J. F. W.; Fathimani, A. A.; Seth, T. N. (UKAEA, Springfields, Eng.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A description is given of an ultrasonic thermometer. Included are discussions on the acoustic principles employed, probe acoustics, electronic circuits, signal generator, operating cycle, error measurement, the control system, and probe materials and instrument performance. (DG)

22546 (EUR-5395(Vol.2), pp 681-699) IN-PILE ULTRASONIC THERMOMETRY EXPERIMENT TRESON. Tasman, H. A.; Campana, M.; Fayl, G.; Schmidt, H. E. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The TRESON experiment demonstrated the possibility of measuring the axial central temperature profile in fuel pins up to 2400°C by means of ultrasonic thermometers. A mixed oxide fuel pin was instrumented with ultrasonic transducers at both ends (a double and a triple sensor). The pin was irradiated in the High Flux Reactor at Petten. During heating up to 2400°C in seven hours, both thermometers performed excellently with an estimated scatter of ±15°C. After 15 hours, the signals from both systems were obscured by spurious echoes. The upper system, with a triple sensor, recovered by rapid cooling. In spite of the fact that the echoes became more and more disturbed, they could be identified and measured through nearly all the 350 hours of irradiation (270 hours above 2300°C). Except for the first seven hours, the disturbances were too large for the original calibration to be applied. Up to 280 hours, the upper thermometer responded reproducibly to temperature changes of the order of ±5°C. At the end of the irradiation the system supported repeated rapid cycling between 2680 and 1000°C. Central temperatures were computed from the cladding temperatures at the same axial positions, using the correlation from the first seven hours with an estimated correction for fuel restructuring. The displacement of the echo positions was calculated as a function of time and temperature. Fuel-to-cladding heat transfer coefficients were computed for the first seven hours of operation. (auth)

22547 (EUR-5395(Vol.2), pp 701-732) USE OF TUNGSTEN-2% THORIA ULTRASONIC TRANSMISSION LINE AND SENSOR TO IMPROVE THE PERFORMANCE OF HIGH TEMPERATURE ULTRASONIC THERMOMETRY. Arave, A. E.; Buchenauer, J. (Aerojet Nuclear Co., Idaho Falls, ID). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Aerojet Nuclear Company has been involved in the development of the ultrasonic thermometer for use in measuring nuclear fuel rod centerline temperatures. Development efforts have been applied toward increasing the useful range of the device and in preventing the sheath-to-sensor sticking problem which occurs at high temperatures. Classically high temperatures are determined ultrasonically by measuring the propagation time between echoes generated at discontinuities placed along a refractory metal ultrasonic transmission line. At temperatures above approximately 1600°C the transmission line often bonds to the protective sheath at contact points. Noise echoes are generated at these bonding points, that, at times, mask out the signal echoes. A tungsten-2% thoria ultrasonic transmission line and sensor offers low attenuation characteristics at high temperatures which allows use of standoffs to provide isolation from the sheath. The ultrasonic characteristics of the tungsten-2% thoria sensor and the standoffs are discussed. Also, decalibration due to transmutations in a nuclear environment is addressed. (auth)

22548 (EUR-5395(Vol.2), pp 733-736) PERFORMANCE REPORT OF AN ULTRASONIC THERMOMETER. Ward, D. (AERE, Harwell, Eng.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Group, Harwell. Atomic Energy Research Establishment).

Ultrasonic thermometer developmental studies performed at Harwell are described. Performance test results are discussed, and modifications are proposed to overcome some of the difficulties encountered. (DG)

22549 (EUR-5395(Vol.2), pp 737-774) ULTRASONIC AND JOHNSON NOISE FUEL CENTERLINE THERMOMETRY. Sheppard, R. L.; Borkowski, C. J.; East, J. K.; Fox, R. J.; Horton, J. L. (Oak Ridge National Lab., TN). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Rhenium ultrasonic (UST) and Johnson noise (JNT) thermometers were used to measure fuel centerline temperatures of 900–1500°C in capsules irradiated in the HFIR for periods of 1000–3000 hrs. Transmutation of rhenium by thermal neutron absorption caused large drifts in UST calibration but none in JNT calibration. Whole capsule, post irradiation calibration was used to measure drift in UST and to provide a calibration correction. Calculation of the temperature and the resistance of JNT rhenium sensor elements by noise power measurements have shown no temperature drift in over 1100 hrs at 1250°C. Performance of W–Re thermocouples UST and JNT in fuel irradiation centerline thermometry is compared. (auth)

22550 (EUR-5395(Vol.2), pp 775-795) DEVELOPMENTS IN THE FIELD OF NOISE THERMOMETRY IN THE KFA, JUELICH. Brixy, H.; Rittinghaus, K. F.; Gaertner, K. J.; Hecker, R. (KFA, Juelich, Ger.). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Included are comments on noise thermometry as an operational measuring method at very high temperatures. The system electronics, measuring probe, and a combined thermoelement-noise thermometer are discussed. (DG)

22551 (ORNL-5035) FLANGE: A COMPUTER PROGRAM FOR THE ANALYSIS OF FLANGED JOINTS WITH RING-TYPE GASKETS. Rodabaugh, E. C.; O'Hara, F. M. Jr.; Moore, S. E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 139p. Dep. NTIS $7.75.

The computer program FLANGE was written to calculate not only the stresses due to moment loads on the flange ring but also stresses due to internal pressure; stresses due to a temperature difference between the hub and ring; and stresses due to the variations in bolt load that result from pressure, hub-ring temperature gradient, and/or bolt-ring temperature difference. The program FLANGE is applicable to tapered-hub, straight, and blind flanges. The analysis method is based on the differential equations for thin plates and shells. The stresses due to moment loading calculated by the two methods are essentially identical for identical boundary conditions. A description of the general model of flanges used in the theoretical development of the computer code is provided. The actual mathematical expressions for calculating stresses and displacements due to moment and pressure loads are derived. Example calculations, listings, and flowcharts of the program and its subroutines are included as appendices. (auth)

22552 USE OF VARIATIONAL TECHNIQUES FOR THE ESTIMATION OF NEUTRON DETECTION EFFICIENCY. Lin, S. C. (Univ. of Tennessee, Knoxville); Robinson, J. C.; Flanagan, G. F. Trans. Am. Nucl. Soc.; 22: 239-240(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22553 SELECTION OF DESIGN METEOROLOGY FOR SAFETY-RELATED SPRAY POND SYSTEMS. Myers, D.; Rabin, E. (Bechtel Corp., San Francisco). Trans. Am. Nucl. Soc.; 22: 508-509(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22554 EVALUATION OF COMBINED THERMAL STORAGE POND AND COOLING TOWER SYSTEMS. Guyer, E. C.; Golay, M. W. (Massachusetts Inst. of Tech., Cambridge). Trans. Am. Nucl. Soc.; 22: 509-510(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22555 CONTROL OF VENDOR QUALITY. Wilcox, J. F. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 529-530(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22556 CRITERIA FOR REACTIVITY ANOMALY MONITORING IN NUCLEAR REACTORS. Bullock, J. B. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 558-559(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22557 ANALYSIS AND UPGRADING OF SWING-TYPE STEAM VALVES. Lufrano, I. A.; Kan, C. G.; Kountouras, N. V.; Heifetz, J. H.; Iotti, R. C. (Ebasco Services, Inc., New York, NY). Trans. Am. Nucl. Soc.; 22: 561-562(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22558 EXPERIMENTAL STUDIES OF TUBE/BAFFLE INTERACTION IN HEAT EXCHANGERS. Shin, Y. S.; Jendrzejczyk, J. A.; Wambsganss, M. W. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 563-565(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22559 DYNAMICS OF TUBE/BAFFLE INTERACTION IN HEAT EXCHANGERS. Shin, Y. S.; Sass, D. E.; Wambsganss, M. W. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 565-566(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22560 EXACT METHOD FOR VIBRATIONS OF CIRCULAR CYLINDRICAL SHELLS. Chung, H. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 568-569(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22561 RESPONSE OF REACTOR INTERNALS TO FLUCTUATING PRESSURE FORCES. Au-Yang, M. K. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 569-570(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22562 APPLICATION OF SNEAK CIRCUIT ANALYSIS TO NUCLEAR REACTOR SYSTEMS. Bell, M.; Beard, J. T. (Energy Research and Development Administration, Washington, DC). Trans. Am. Nucl. Soc.; 22: 609(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22563 QUANTIFICATION OF EQUIPMENT AND OVERALL PRODUCT RELIABILITY. Kelly, W. M.; Ashwell, E. P.; Tulodieski, D. B. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 614(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22564 REACTOR INSPECTION TECHNOLOGY. Proceedings of the Symposium on Reactor Inspection Technology Held at Bristol, England, 26 February 1975. London; Thomas Telford Ltd. (1975). vp. (CONF-750240–).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975).

Fourteen papers were presented, describing techniques and equipment for reactor inspection. Individual papers dealt with inspection of components in Magnox reactors, AGR, SGHWR and Fast Reactors. The systems included ultrasonic testing, acoustic emission testing and the use of laser beams. Manipulators and remote viewing equipment were described. All the papers were in NSA scope and separate abstracts were prepared for each. (UK)

For abstracts of individual papers see: 22058–22062, 22081, 22095, 22096, and 22565–22570.

22565 IN-SERVICE INSPECTION AS AN AID TO STEEL PRESSURE VESSEL RELIABILITY. Nichols, R. W. (United Kingdom Atomic Energy Authority Research Group, Risley, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240–.

In-service inspection has played an important role in non-nuclear pressure vessel technology, being a legal requirement in many countries. Evidence from surveys of reliability of non-nuclear plant has suggested that such inspections can be effective in reducing the risk of subsequent failures. Recent requirements of the ASME XI code are summarized which have important implications on the techniques to be used for in-service inspection, and so on design and fabrication aspects. The potential of different ultrasonic techniques is compared. Some presentational aids to defect detection and interpretation are discussed. (auth)

22566 ACOUSTIC EMISSION MEASUREMENTS ON THICK WALLED DUCTILE STEEL PRESSURE VESSELS. Bentley, P. G.; Dawson, D. G. (United Kingdom Atomic Energy Authority Research Group, Risley, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.

The development of the UKAEA acoustic emission monitoring system has continued, directed towards its use to prevent pressure vessel failure in materials of general engineering practice. The acoustic facility, SWEL, can locate sources on large vessels to ±3 inches and has a two-dimensional display, on line, of the emission sources. Measurements have been made of the location of artificial and natural defects in two experimental ductile steel vessels and on the US EBOR test vessel. Defects of a brittle nature are shown to emit strongly and can be readily detected. Defects in parent plate are shown to be quiet when significant crack growth is occurring, in accord with results from metallurgical specimens. No signals are detected during periods of yielding around defects in vessels in spite of indications from specimens that low level emission occurs. (auth)

22567 INFLUENCE OF INSPECTION REQUIREMENTS ON REACTOR DESIGN. Gibbs, K. P. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.

The intense radioactivity of the core of any nuclear reactor makes inspection and repair much more difficult than with conventional power plants. Early commercial nuclear reactors met this situation by trying to design all components so that they needed no inspection or repair during their life. Experience has shown that repairs are both necessary and possible, and reactor designs are therefore evolving in a direction to make inspection and, if necessary, subsequent repairs or replacement possible. The direction of this evolution for the various thermal reactor systems and the inspection requirements for fast reactors are outlined. (auth)

22568 OPERATION OF AN ACOUSTIC EMISSION DEFECT LOCATION SYSTEM IN INDUSTRIAL CONDITIONS. Sinclair, A. C. E.; Tobias, A.; Connors, D. C. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.

An Acoustic Emission Analysis system (ACEMAN) designed for acoustic source location was used to monitor the proof test of a large industrial pressure vessel. The extensive surveillance region included a representative sample of welds and nozzle array complexity. In spite of a large noise background (since the test was conducted according to standard industrial procedures) sophisticated signal discriminators and multi-sensor timing correlation permitted location of several distinct areas of acoustic activity. Differing emission patterns with pressure pointed to a variety of source mechanisms. Factors important to the acoustic emission assessment of structural integrity are discussed. (auth)

22569 ULTRASONIC TECHNIQUES FOR MATERIALS AND COMPONENT ASSESSMENT. Harper, H.; Oates, G. (Central Electricity Generating Board, Barnwood, Eng.). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.

Ultrasonic testing is applied in manufacture and is the preferred method for in-service volumetric examination of nuclear systems. Nuclear applications have put a greater emphasis on automatic inspection techniques which can be applied remotely and have the potential to give reliable and reproducible performance. These applications have also highlighted the need for quantitative assessments of technique performance and for permanent records of the test results. Technical developments in the G.E.G.B. are considered which have an important bearing on these requirements. The developments include probe assessments and investigation of ultrasonic scattering in austenitic materials. Studies of ultrasonic reflection from defects indicate the limitations of sizing methods and relate to the probability of detecting defects at specific sensitivity levels as prescribed by published Codes. The development of improved display methods is included, and the advantages of numerical methods of recording and analyzing data are discussed. Emphasis is placed on the crucial importance of design details in influencing the effectiveness of ultrasonic inspection and the need to compare inspection performance with the defect acceptance standard to be enforced. (auth)

22570 MATHEMATICAL MODEL OF HIGH TEMPERATURE TRANSDUCER. Fabre, J. P. (CEN de Cadarache, Saint-Paul-les-Durance, France). pp vp of Symposium on Reactor Inspection Technology. London; Thomas Telford Ltd. (1975).

From conference on reactor inspection; Bristol, Somerset, UK (26 Feb 1975). See CONF-750240-.

The utilization of the electro-acoustic transducer leads to two kinds of problems. The first one consists of constructing a transducer which has some electro-acoustic performance, the second one consists of finding the electro-acoustic performance of a given transducer. By the method proposed it is possible to solve these two problems in certain cases. (auth)

22571 STRUCTURE OF NEW TYPE REACTOR PRIMARY CONTAINMENT VESSEL. Wada, T. (Hitachi Ltd., Tokyo). Hitachi Hyoron; 56: No. 8, 1-6(Aug 1974).

A light bulb-torus type (MARK-I type) containment vessel, in which a torus-shaped suppression chamber is provided around the light bulb-shaped drywell, has been used mainly, but recently, an over-under type (MARK-II type) containment vessel which has a frustum drywell over a cylindrical suppression chamber has come to be used increasingly because of its advantages in respect of safety, maintenance and the control of the reactor. The article compares the MARK-II with the MARK-I in such points as applicable codes, structure, materials, fabrication and inspection, also giving a description of the characteristics of the MARK-II. (Electr. Electron. Abst.)

22572 ELECTRICAL CABLE PENETRATION ASSEMBLY FOR PRIMARY CONTAINMENT VESSEL OF NUCLEAR REACTOR. Igarashi, T.; Kato, Y.; Takumi, K. (Hitachi Ltd., Tokyo). Hitachi Hyoron; 56: No. 8, 13-18(Aug 1974).

The electrical cable penetration assembly for primary containment vessels for nuclear reactors needs to be capable of preventing the leakage of radioactive substances under normal operating conditions as well as emergency conditions of the reactor. For the purpose of research in this connection the authors manufactured three different types of electrical cable penetration assembly in actual scale, including: Medium voltage cable penetration assembly for large (5000V) power cables, low voltage cable penetration assembly for 600V power control and instrumentation cables, and shielded signal cable penetration assembly for shielded and unshielded signal cables. In a series of tests which were carried out under normal operating conditions (66°C) and emergency conditions (171°C, 4.5 kg/cm^{2}G, 6 hours; 138°C, 4.5 kg/cm^{2}G, 10 days) of the reactor, they proved to have good performance. (Electr. Electron. Abstr.)

22573 RIGOROUS CONTROL AND SUPERVISION FOR SECURE NUCLEAR POWER STATIONS. Bergstrom, G.; Printz, G. Tek. Tidskr.; 104: No. 15, 23-26(Oct 1974). (In Swedish)

Experience from the Association for the Supervision and Inspection of Boilers' activities shows that these controls demand major and thoroughgoing work. The scope of the inspection depends on various security categories, and stringent manufacturing control for sensitive components is essential. Some of the precautions employed are listed and illustrated. (Electr. Electron. Abst.)

22574 RATIONAL LAYOUTS OF STRAIGHT-TUBE HEAT EXCHANGERS FOR NUCLEAR STATION REHEATERS. Lipets, A. U.; Fadeev, E. A.; Moskvichev, V. F.; Spiridova, N. M.; Manaenkov, V. I.; Kudel'kina, A. N. Therm. Eng. (USSR) (Engl. Transl.); 21: No. 11, 62-66(Nov 1974).

Translated from Teploenergetika; 21: No. 11, 42-46(Nov 1974).

22575 ACOUSTIC EMISSION: A CRITICAL ASSESSMENT. Stahlkopf, K. E.; Dau, G. J. Nucl. Saf.; 17: No. 1, 33-43(1976).

The purpose of the article presented is to highlight the limitations of acoustic emission for use in hydrostatic test monitoring and continuous monitoring of pressure vessels as determined from a review of prior work. With the present state of the art for monitoring structural integrity, acoustic emission can probably reveal abnormal incidents and their locations, but it cannot describe the incident or its seriousness. Specific conclusions about the maturity of acoustic-emission monitoring are drawn, and suggestions are given for future research and development efforts. (auth)

22576 IMPROVING REACTOR PRESSURE-VESSEL AVAILABILITY BY DESIGN. Cooper, W. E. (Teledyne Materials Research, Waltham, MA). Nucl. Saf.; 17: No. 1, 62-67(1976).

Although reactor pressure vessels are safe, they presently contribute to the unavailability time of nuclear power systems. This effect could be reduced significantly by better application of the now available design technology. A brief description is presented of the status of this technology, as pertinent to reactor pressure-vessel availability, and the application of this technology

during the construction and operation phases. Recommendations are made as to how this technology could be applied to improving vessel availability. (auth)

22577 SAFETY OF REACTOR PRESSURE VESSELS. Cooper, W. E. (Teledyne Materials Research, Waltham, MA); Langer, B. F. Nucl. Saf.; 17: No. 1, 55-61(1976).

Debate on the subject of reactor pressure vessels has ranged from purely emotional arguments to lengthy and complicated statistical studies. A summary statement is presented which contains a brief description of the technology and of the manner in which the technology is implemented in vessel construction. (auth)

22578 ELECTRONICS AND NUCLEAR POWER. Cox, R. J. (United Kingdom Atomic Energy Authority Reactor Group, Winfrith, Eng.). Radio Electron. Eng.; 45: No. 10, 603-609(Oct 1975).

The development of nuclear power stations and the attendant electronics, including radiation measurement, are reviewed. Recent developments display a much greater emphasis on systems engineering aspects such as that of electrical interference reduction which has frequently been a source of trouble in nucleonic equipment for nuclear power plants. The use for reactor safety and control systems of increasingly sophisticated techniques using computers and statistical methods is discussed. Future trends are discussed, and the achievement of electronic equipment which can be fitted and forgotten are considered. (UK)

22579 HEAT EXCHANGER. Bennett, J. C. (to Clarke Chapman Ltd.). British Patent 1,404,643/B/. 3 Sep 1975. Filed date 13 Sep 1972. 4p.

A heat exchanger such as forms, for example, part of a power steam boiler is made up of a number of tubes that may be arranged in many different ways, and it is necessary that the tubes be properly supported. The means by which the tubes are secured must be as simple as possible so as to facilitate construction, and the supports must be able to continue to function effectively under the varying operating conditions to which the heat exchanger is subject. The arrangement described is designed to meet these requirements in an improved way. The tubes are secured to a member extending past several tubes and, abutment means are provided. At least some of the abutment means comprise two abutment pieces and a wedge secured to the supporting member that acts on these pieces to maintain the engagement. (UK)

22580 METHOD AND APPARATUS FOR REMOVING AN INCORE NEUTRON FLUX MONITOR. Tsuji, T.; Watanabe, S. (to Tokyo Shibaura Denki Kabushiki Kaisha). US Patent 3,910,816. 7 Oct 1975. Priority Date 5 Sep 1973, Japan. 6p.

In a nuclear reactor wherein four square shaped fuel rod assemblies are disposed in respective square shaped openings defined by crossing grids of an upper supporting plate, and an in-core monitor is disposed at a cross-point of the grids, the in-core monitor is removed by removing four fuel rod assemblies adjacent the in-core monitor, removing one fuel rod assembly from each of three square shaped openings about the in-core monitor, inserting a holder-cutter assembly into a large vacant space formed by removing the four fuel rod assemblies for holding the upper portion of the in-core monitor, inserting a clamping device into one small vacant space formed by removing one of the three fuel rod assemblies which is diagonally opposite the removed fuel rod assembly for clamping a portion of the in-core monitor which is spaced apart from the portion thereof held by the holder of the holder-cutter assembly, severing the in-core monitor into two sections by operating the cutter, and removing to the outside of the reactor the severed two sections while they are held by the clamping device and the holder, respectively. (Official Gazette)

22581 DEVICE FOR HANDLING FUEL ASSEMBLIES WITHIN A NUCLEAR REACTOR CORE. Dupuy, G. (to Commissariat a l'Energie Atomique). US Patent 3,909,350. 30 Sep 1975. Priority Date 18 May 1972, France. 8p.

A device is described which comprises two arms having synchronized movements, the tubular portions of the two arms being rigidly fixed to each other by means of a sliding connection and capable of being endowed by means of a differential drive system with movements for producing the same effort but applied in the opposite direction in order that the lateral reaction on the grab of the first arm on a fuel assembly should be equal and opposite to the lateral reaction of the cylindrical guide tube of the second arm on the same fuel assembly. (Official Gazette)

22582 CORE FOR NUCLEAR REACTORS. Andersson, I.; Eriksson, O. (to ASEA-ATOM). US Patent 3,913,689. 21 Oct 1975. Priority Date 11 Aug 1972, Sweden. 2p.

A description is given of a core for a nuclear reactor which includes a moderator tank and fuel assemblies within the moderator tank. The tank has a lid. The fuel assemblies are fixed by an assembly grid shaped as a lattice, each fuel assembly including a polygonal shroud and a plurality of control rod guide tubes surrounded by the shroud. The walls of the shrouds extend upwardly above the control rod guide tubes. The grid is secured in place by the lid of the moderator tank. The grid has mechanical contact with the upper edges of the shrouds, the vertical planes along the surface of the grids crossing the planes along the surfaces of the shrouds. The mechanical contact is made by downwardly open slots in the sheet metal parts constituting the grid which engage the upwardly extending edges of the shroud. (Official Gazette)

Reactor Fuels

Refer also to abstracts 19671, 20628, 20867, and 20928.

22583 (EUR-5395(Vol.2), pp 623-632) FABRICATION OF INTERNALLY INSTRUMENTED REACTOR FUEL RODS. Schmutz, J. D.; Meservey, R. H. (Aerojet Nuclear Co., Idaho Falls, ID). 1975.

From international colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In international colloquium on high-temperature in-pile thermometry. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Procedures are outlined for fabricating internally instrumented reactor fuel rods while maintaining the original quality assurance level of the rods. Instrumented fuel rods described in this report contain fuel centerline thermocouples, ultrasonic thermometers, and pressure tubes for internal rod gas pressure measurements. Descriptions of the thermocouples and ultrasonic thermometers are also contained. (auth)

22584 (NUREG-75/077) ROLE OF FISSION GAS RELEASE IN REACTOR LICENSING. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Nov 1975. 87p. NTIS $5.00.

The release of fission gases from oxide pellets to the fuel rod internal voidage (gap) is reviewed with regard to the required safety analysis in reactor licensing. Significant analyzed effects are described, prominent gas release models are reviewed, and various methods used in the licensing process are summarized. The report thus serves as a guide to a large body of literature including company reports and government documents. A discussion of the state of the art of gas release analysis is presented. (auth)

22585 RADIATION EFFECTS PROBLEMS IN NUCLEAR FUEL RODS. Roberts, J. T. A. (Electric Power Research Inst., Palo Alto, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 6, 2219-2226(Dec 1975).

From annual conference on nuclear and space radiation effects; Arcata, CA (14 Jul 1975).

Some of the radiation effects problems that have been encountered in nuclear fuel rods are reviewed. Examples are drawn from both the commercial Light Water Reactors (LWR) and the new, developing Liquid Metal Fast Breeder Reactors (LMFBR). The performance of a particular fuel rod is influenced by (1) the interaction between the ceramic fuel pellet column and the metal cladding tube, and (2) the interactions of the fuel cladding, separately, with the reactor core environment. The latter includes the effect of neutron flux, temperature, stress and corrosive chemicals. Despite this complex and hostile environment, many of the material interactions are known. Sufficient new detail will enable the fuel rod and the core power operation to be designed so that a very low incidence of fuel rod failures can be maintained. (auth)

22586 CREEP-FRACTURE ANALYSIS OF FUEL ELEMENT CLADDING. Chopra, P. S.; Wu, T. S. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 181-182(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22587 DENSIFICATION KINETICS IN UO_2 FUELS. Buescher, B. J.; Horn, G. R. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Am. Nucl. Soc.; 22: 205-206(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22588 IN-REACTOR RESTRUCTURING STUDIES OF UO_2. Stora, J. P.; Hueber, C. (CEN, Grenoble, France). Trans. Am. Nucl. Soc.; 22: 208-209(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22589 STEADY-STATE CREEP MODEL FOR UO_2. Olsen, C. S. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 210-211(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22590 OPTIMAL PIN ENRICHMENT DISTRIBUTIONS: THE COMBINATORIAL CASE. Lim, E. Y. (Stanford Univ., CA); Leonard, A. Trans. Am. Nucl. Soc.; 22: 243(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22591 QUALITY ASSURANCE IN NUCLEAR FUEL FABRICATION. Trumble, R. E. (Exxon Nuclear Co., Richland, WA). Trans. Am. Nucl. Soc.; 22: 357(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22592 SOME ELEMENTS OF AN EFFECTIVE NUCLEAR FUEL QUALITY ASSURANCE PROGRAM. Cost, R. R. (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 357-358(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22593 QUALITY ASSURANCE FOR FUEL SUPPLY. Libotte, M. P. (Belgonucleaire, Brussels). Trans. Am. Nucl. Soc.; 22: 358-359(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22594 RESULTS OF QA INSPECTIONS AT FUEL VENDORS. Tripp, L. E. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 359(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22595 THERMAL CONDUCTIVITY AND TEMPERATURE JUMP DISTANCE OF GAS MIXTURES. Vickerman, R. H.; Harris, R. (Combustion Engineering, Inc., Windsor, CT). Trans. Am. Nucl. Soc.; 22: 523(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22596 CONSISTENT ALGORITHM FOR THE STUDY OF HEAT TRANSFER IN ECCENTRIC ANNULI. Peddicord, K. L. (Swiss Federal Inst. for Reactor Research, Wuerenlingen); Ganapol, B. D.; Henninger, R. Trans. Am. Nucl. Soc.; 22: 572-573(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22597 ANALYTICAL ERROR COMPARISON OF THREE METHODS FOR EXPERIMENTALLY OBTAINING GAP CONDUCTANCE VALUES. Tolman, E. L.; Wells, M. E. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Am. Nucl. Soc.; 22: 580-581(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22598 IMPROVEMENTS IN OR RELATING TO PLUGS. Clapham, L. (to United Kingdom Atomic Energy Authority). British Patent 1,404,234/B/. 28 Aug 1975. Filed date 15 Sep 1972. 4p.
Means are described with the object of improving the integrity of the closure of nuclear reactor fuel cans. Before can closures are made during the manufacture of canned fuel the interior of the cans is evacuated, and may be filled with an inert gas, with a view to removing any foreign substance that subsequently may cause chemical reactions which may affect the integrity of the can. In spite of these precautions it is difficult to ensure that the removal of foreign substances is complete, since some gases and especially water vapor may remain adsorbed on solid surfaces comprising the can, and on irradiation and subjection to high temperatures in a reactor may appear in the free state and cause trouble. An example is Zr, which is prone to adsorb H_2 and cause the formation of hydride, with possible breach of the can. The can described has a closure plug dimensioned to engage the open end of the can, with a stem of reduced cross section extending axially from the dimensioned portion into the can interior, the stem terminating in a flange of enlarged cross section formed of a material that is susceptible of attack by H_2, for example Zr or Zr alloy. The flange may have a surface roughness greater than that of the interior surface of the can, and it may be grooved. The plug and the can are seal welded. The plug may have an intermediate portion between the flange and the closure portion so as to form a sharply falling temperature gradient zone to encourage and Zr hydride formed in the flange to migrate away from the flange and towards the intermediate portion. (UK)

22599 INSPECTION AND REPAIR APPARATUS FOR A NUCLEAR REACTOR FUEL ASSEMBLY. Shallenberger, J.M.; Hornak, L. P.; Desmarchais, W. E. (to Westinghouse Electric Corp.). US Patent 3,914,613. 21 Oct 1975. Filed Date 6 Feb 1974. 8p.
An apparatus is disclosed for inspecting and repairing a radioactive fuel assembly. The radioactive fuel assembly is positioned within a shielding sleeve which substantially reduces the level of radioactivity immediately surrounding the sleeve thereby permitting direct access by operating personnel. In one embodiment, a rotatable collar is mounted to the sleeve at a mid-length location. An access port, an inspection port and an instrument port are included with the collar so that operating personnel may directly inspect the fuel assembly and effectuate any necessary repairs. (Official Gazette)

22600 RESTRAINT SYSTEM FOR CORE ELEMENTS OF A REACTOR CORE. Class, G. (to Gesellschaft fuer Kernforschung mbH). US Patent 3,900,367. 19 Aug 1975. Priority Date 15 Dec 1971, German, Federal Republic of (F. R. Germany). 8p.
In a nuclear reactor, a core element bundle formed of a plurality of side-by-side arranged core elements is surrounded by restraining elements that exert a radially inwardly directed restraining force generating friction forces between the core elements in a restraining plane that is transverse to the core element axes. The adjoining core elements are in rolling contact with one another in the restraining plane by virtue of rolling-type bearing elements supported in the core elements. (Official Gazette)

Reactor Control Systems

22601 PERFORMANCE ANALYSIS OF LMFBR CONTROL RODS. Pitner, A. L.; Birney, K. R. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 225-226(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22602 ESTIMATION AND OPTIMAL FEEDBACK CONTROL THEORY APPLIED TO A NUCLEAR BOILING WATER REACTOR. Frogner, B. (Univ. of California, Berkeley). Trans. Am. Nucl. Soc.; 22: 236(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22603 PERFORMANCE OPTIMIZATION OF LWR CORES UNDER VARIABLE LOAD OPERATION. Versluis, R. M.; Blomsnes, B.; Karppinen, J. (OECD, Halden, Norway). Trans. Am. Nucl. Soc.; 22: 236-237(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22604 ON-LINE REACTOR SURVEILLANCE ALGORITHM BASED ON MULTIVARIATE ANALYSIS OF NOISE. Piety, K. R.; Robinson, J. C. (Univ. of Tennessee, Knoxville). Trans. Am. Nucl. Soc.; 22: 237-239(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22605 CONTROL ALGORITHMS IN A COARSE-MESH REBALANCE FRAMEWORK. Gregory, M. V.; Honeck, H. C. (Savannah River Lab., Aiken, SC). Trans. Am. Nucl. Soc.; 22: 241(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22606 ON-LINE CORE PERFORMANCE PREDICTION OF BWR. Nishizawa, Y.; Kiguchi, T.; Motoda, H. (Atomic Energy Research Lab., Kawasaki, Japan). Trans. Am. Nucl. Soc.; 22: 242-243(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22607 MINICOMPUTER-BASED SURVEILLANCE AND DIAGNOSTICS FOR NUCLEAR POWER PLANTS. Mott, J. E.; Robinson, J. C. (Univ. of Tennessee, Knoxville). Trans. Am. Nucl. Soc.; 22: 289(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22608 MAGNETIC CURIE POINT INHERENT SHUTDOWN ASSEMBLY (ISA) FOR LMFBR PLANTS. Sowa, E. S.; Josephson, J. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 541-542(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Nuclear Power Plant Economics

Refer also to abstracts 20186, 21995, and 22074.

22609 (AAEC/IP-10) ENERGY ACCOUNTING IN NUCLEAR POWER SYSTEMS. Symonds, J. L.; Essam, P.; Stocks, K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1975. 29p. Dep. NTIS (US Sales Only) $4.00.

The application of energy accounting to nuclear power stations and their growth in generating systems is discussed. Misunderstandings arising from discrepancies and weaknesses in some published simple analyses of hypothetical growth situations are outlined. Results of a more complex energy flow analysis are used to demonstrate that current nuclear energy programs are running at an energy profit. Large fossil fuel savings will occur in a real electrical grid system under anticipated nuclear power growth rates. (auth)

22610 (CONF-750117-P1) INTERNATIONAL SYMPOSIUM ON NUCLEAR POWER TECHNOLOGY AND ECONOMICS, JANUARY 13-20, 1975, TAIPEI, REPUBLIC OF CHINA. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)). 1975. 622p. National Science Council, Taipei, Taiwan.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

Nineteen papers are presented on aspects of nuclear power technology and economics relevant to countries in the Far East in developing a program of commercial nuclear energy. A separate abstract was prepared for each of 17 papers. Two papers were previously cited in NSA. (HDR)

For abstracts of individual papers see: 20431, 21945-21947, 21977-21979, 22308, 22309, 22518, 22611-22614, and 22629-22631.

22611 (CONF-750117-P1, pp 29-69) ECONOMICS OF NUCLEAR POWER. Davis, W. K. (Bechtel Power Corp., San Francisco). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

Finance costs, fuel costs, and operation and maintenance costs for thermal power plants are reviewed. Reasons for the dramatic change in capital costs for power plants are discussed. It is shown that nuclear power plants still have an economic edge over conventional power plants in spite of the increased capital costs. (JWR)

22612 (CONF-750117-P1, pp 71-98) INFLUENCE OF FUTURE ECONOMIC AND TECHNICAL TRENDS ON REACTOR DESIGN, SELECTION AND OPERATION. Spinrad, B. I. (Oregon State Univ., Corvallis). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

Some forecasts concerning the effect of economic and industrial circumstances on reactor design, selection, and operation are presented. The general assumptions concerning the nuclear industry and social trends on which the forecasts are based are discussed. Forecasts are presented concerning designs, plant capacities, capital costs, construction times, ore and enrichment costs, plutonium recycle, and reprocessing. (JWR)

22613 (CONF-750117-P1, pp 123-132) ENERGY CONSERVATION AND ECONOMICS. Zweifel, P. F. (Rockefeller Univ., New York); Guynn, A. 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

As developing countries begin to consume larger proportions of Middle Eastern oil, the shortages in Europe and North America will increase. Proposed energy conservation measures are analyzed and it is concluded that they can afford trivial savings. Only substantial decrease in industrial production can save meaningful amounts of energy. But decreased production has serious economic influences throughout the world. For example, the effect of a ten percent decrease in production of gasoline would increase unemployment in the U.S. by one million and decrease GNP by $\$20 \times 10^9$. This will precipitate similar problems in countries with which we trade. The solution is to develop new energy resources immediately. The fission reactor is the best choice for many reasons. There is adequate coal in the U.S., but its development proves serious ecological and health problems. Equally important is the fact nuclear power development instead of coal would provide energy which could be used in any part of the world with minimal cost of transportation. (auth)

22614 (CONF-750117-P1, pp 277-302) INTEGRATION OF NUCLEAR POWER PLANTS INTO EXISTING SYSTEMS. Jenkins, R. T. (Tennessee Valley Authority, Chattanooga). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

Introduction of nuclear generating units into an existing fossil-hydro system produces challenging problems in analysis for the system planner and the system operator. When the units are batch loaded, the analysis problems are even more difficult. Traditionally, fossil unit operation has been optimized essentially by optimizing instantaneous operation. Hydro optimum operation has been developed around historical river flows and balancing of the incremental value of hydro generation against the cost of alternative fossil operation within external constraints imposed on the hydro system. Scheduling of fossil unit maintenance could, with minor inconvenience, be altered on short notice. The effective and economical utilization of batch loaded nuclear reactors requires the development of new planning methods to avoid severe penalties in reliability and financial expenditure. Whereas uncertainties created many problems in planning and operating fossil systems, they become crucial to planning and operating systems with nuclear reactors. Recognition of seasonal load patterns, load forecast reliability, unplanned equipment outages, the state of all reactor cores, lead time and other procurement constraints on nuclear fuel-cycle materials and services, and environmental considerations is required. Economic penalties associated with low load factor operation of nuclear plants require careful analysis to determine the best mix of generating equipment. Some of the problems and some of the analysis methods that are under development are surveyed. (auth)

22615 (CONF-750117-P2) INTERNATIONAL SYMPOSIUM ON NUCLEAR POWER TECHNOLOGY AND ECONOMICS, JANUARY 13-20, 1975, TAIPEI, REPUBLIC OF CHINA. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)). 1975. 652p. National Science Council, Taipei, Taiwan.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

Twenty-three papers are presented on aspects of nuclear power technology and economics relevant to countries in the Far East in developing a program of commercial nuclear energy. A separate abstract was prepared for each of 21 papers. Two papers were also processed for inclusion in ERDA Research Abstracts. One paper was previously cited in NSA. (HDR)

For abstracts of individual papers see: 19771, 20918, 21948-21950, 22003, 22038, 22072-22075, 22088, 22089, 22217, 22310-22314, 22483, and 22640.

22616 EFFECT OF PLANT AVAILABILITY AND CONSTRUCTION DELAYS ON UTILITY ENERGY POLICY. Martin, J. G. (Univ. of Lowell, MA); de la Fuente, H.; Mulas, P. Trans. Am. Nucl. Soc.; 22: 499(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22617 FUEL SENSITIVITY OF FOSSIL-NUCLEAR ECONOMICS. James, J. Z. (Kaiser Engineers, Oakland, CA). Trans. Am. Nucl. Soc.; 22: 499-500(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22618 COMPARISON BETWEEN NUCLEAR-GENERATED STEAM AND GEOTHERMAL STEAM FOR USE AS PROCESS HEAT. Valfells, A. (Iowa State Univ., Ames). Trans. Am. Nucl. Soc.; 22: 500-501(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22619 ENERGY PARKS VERSUS DISPERSED SITING OF POWER GENERATION CAPACITY. Finger, H. B. (General Electric Co., Washington, DC). Trans. Am. Nucl. Soc.; 22: 503 (Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22620 NUCLEAR ENERGY CENTERS: A UTILITY PERSPECTIVE. Kearney, J. J. (Edison Electric Inst., New York). Trans. Am. Nucl. Soc.; 22: 503-504(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22621 ECONOMIC COMPARATIVE ANALYSES OF NUCLEAR ENERGY PARKS AND DISPERSED SITES. Meenan, P. M.; Duersch, R. R. (General Electric Co., Schenectady, NY). Trans. Am. Nucl. Soc.; 22: 506(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22622 SITE STRUCTURES FOR FLOATING NUCLEAR POWER PLANTS. Harlow, E. H.; Posch, A. G. (Frederic R. Harris, Inc., New York). Trans. Am. Nucl. Soc.; 22: 510-511(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22623 NUCLEAR ENERGY AND ELECTRICITY DEMAND. Steizer, I. M. (American National Economics Association, Washington, DC). Trans. Am. Nucl. Soc.; 22: 546-547(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22624 INTERFUEL SUBSTITUTION AND CONSERVATION IN SELF-CONSISTENT ELECTRICAL ENERGY FORECASTS. Devine, W. D. Jr.; Ringle, J. C. (Oregon State Univ., Corvallis). Trans. Am. Nucl. Soc.; 22: 548-549(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22625 RECENT OCCURRENCES AT NUCLEAR REACTORS AND THEIR CAUSES. Scott, R. L. (comp.). Nucl. Saf.; 17: No. 1, 97-106(1976).

22626 ENERGY RESOURCES FOR ELECTRICAL POWER GENERATION: THE CONTRIBUTION FROM NUCLEAR POWER. Boswell, R. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Inst. Nucl. Eng.; 16: No. 5, 148-155(Sep 1975).
The history and rise in the availability of nuclear power as a contribution to electrical power requirements are reviewed both world-wide and for individual countries. The main emphasis in on the USA, the UK, Canada, and Australia. The future situation is also discussed. (UK)

22627 SOME IMPLICATIONS OF NUCLEAR ENERGY POLICIES IN EUROPEAN COUNTRIES. Pierantoni, F. (CNEN, Bologna). J. Br. Nucl. Energy Soc.; 14: No. 4, 303-304(Oct 1975).
The case for nuclear power is argued. The impact of the oil crisis is discussed and a comparative analysis is made between oil and nuclear power for installing a hypothetical 20,000 MW(e) additional capacity. It is urged that Europe must strive to attain maximum nuclear output within the next few years. A brief examination is made of the choice of reactors available and reasons are produced for adopting the PWR system. The advantages of adopting one single standardized plant of fixed capacity are put forward. (UK)

22628 ELECTRIC DIAGRAMS OF ATOMIC POWER PLANTS. Marko, S.; Darul'a, I. Elektrotech. Obz.; 63: No. 11, 683-689 (Nov 1974). (In Czech).
A discussion is presented of some general principles of the construction of electric diagrams of self consumption of atomic power plants and the differences in comparison with classical stam power plants are pointed out. (Electr. Electron Abst.)

Reactor Fuel Cycle Economics

Refer also to abstract 19789.

22629 (CONF-750117-P1, pp 421-467) TRENDS IN FUEL SUPPLY AND CORE MANAGEMENT IN THE UNITED STATES AND ASIA. Macnabb, W. V. (NUS Corp., Rockville, MD). 1975.
From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).
In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).
The current status of the nuclear fuel cycle is reviewed and fuel management practices in the United States and the Far East are compared. The discussion covers both fuel supply and in-core management. (JWR)

22630 (CONF-750117-P1, pp 531-544) PLUTONIUM: WHAT'S IT WORTH. Barrett, R. J.; Chuebon, R. P. (Burns and Roe, Inc., Oradell, NJ). 1975.
From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).
In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).
It is shown that the value of plutonium can make a significant difference to the cost of operating nuclear power reactors. Having flexibility to choose among various plutonium disposition alternatives could be important to the reactor management and should be a consideration in contracting for future fuel cycle services. (auth)

22631 (CONF-750117-P1, pp 545-564) NUCLEAR FUEL MANAGEMENT. Liu, P. C.; Hsu, C. T. (Taiwan Power Co., Taipei). 1975.
From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).
In international symposium on nuclear power technology and economics. Volume I. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).
From a fuel supply arrangement point of view, nuclear reactors inherently respond to changes of power system operation requirements. This feature must be considered in system operation planning and dispatching. Suppliers of various services in nuclear fuel cycle consider their own requirements and offer the kind of services based upon the fitness to their own operation while utilities have to pull them together and often discover these services do not match with each other. Flexibility offered by one supplier often has little practical usefulness to a utility with limited number of nuclear units because other steps in the fuel cycle have long before been fixed and difficult to adjust. Utilities have to bear the most of the consequences of reactor operation. A safe and flexible operation of a nuclear unit can best be achieved if the utility has a full knowledge of the reactor behavior and is capable of making predictions of its performance, which can only be realized by having analytical capability. This capability is also essential for supporting out-of-core fuel management. For utilities in this region, the best way to cope with their common fuel management problems such as uranium supply, separative work units, reprocessing, waste disposal, etc. is through mutual assistance programs. (auth)

22632 CONCEPT OF CLOSING THE NUCLEAR FUEL CYCLE IN THE FEDERAL REPUBLIC OF GERMANY. Randl, R.; Hagen, M. Trans. Am. Nucl. Soc.; 22: 302-303(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22633 NUCLEAR FUEL CYCLE AND ENERGY PARKS. McNelly, M. J.; Lieberman, J. A.; Bohl, L. S.; Carson, A. B. (General Electric Co., San Jose, CA). Trans. Am. Nucl. Soc.; 22: 303(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22634 PROPOSED INDEPENDENT SPENT-FUEL STORAGE PROJECT. Johnson, E. R. (E. R. Johnson Associates, Inc., Vienna, VA). Trans. Am. Nucl. Soc.; 22: 308(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22635 COST OPTIMIZATION FOR AN EMERGENCY NUCLEAR FUEL INVENTORY. Kurstedt, H. A. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Cockrell, R. G.; Nachlas, J. A. Trans. Am. Nucl. Soc.; 22: 320-321(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22636 SENSITIVITY OF TOTAL FUEL CYCLE COST TO VARIATIONS IN ENRICHMENT TAILS ASSAY STRATEGIES. Voltin, M. H. Jr.; Draper, E. L. Jr. (Univ. of Texas, Austin). Trans. Am. Nucl. Soc.; 22: 322-324(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22637 COMPARISON OF ADVANCED FISSION REACTORS IN A NUCLEAR POWER ECONOMY. Denning, R. S.; Madia, W. J.; Pardue, W. M.; Pobereskin, M.; Waddell, J. D.; Willke, T. L. (Battelle-Columbus Labs., OH). Trans. Am. Nucl. Soc.; 22: 331-332(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22638 APPLICATION OF THE THORIUM FUEL CYCLE. Kasten, P. R.; Tobias, M. L. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 334(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22639 NUCLEAR REACTORS AND UTILIZATION OF FISSILE MATERIALS. Van Dam, H. (Interuniversity, Delft, Netherlands). Polytech. Tijdschr. Procestech.; 29: No. 20, 647-652 (2 Oct 1974). (In Dutch)
Essential features are summarized for the main types of both thermal and fast reactors employing uranium and/or plutonium fissile isotopes as fuel. Tabulations are presented of fuel utilization efficiencies, including U/Pu conversion ratios, for typical

light-water reactors (both BWRs and PWRs), heavy-water reactors, HTRs and sodium-cooled fast reactors. (Electr. Electron. Abstr.)

Reactor Licensing and Regulation

Refer also to abstract 21988.

22640 (CONF-750117-P2, pp 979-988) PUBLIC INFORMATION PROGRAMS IN A DEVELOPING NUCLEAR ECONOMY. Adams, R. M. (Argonne National Lab., IL). 1975.

From international symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In international symposium on nuclear power technology and economics. Volume II. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)).

The importance of public information programs in the development of nuclear power is discussed. The information programs of Argonne National Laboratory and the former USAEC are reviewed. (JWR)

22641 (NRCI-75/INDEX-1) INDEXES TO NUCLEAR REGULATORY COMMISSION ISSUANCES, JANUARY 19–JUNE 1975. (Nuclear Regulatory Commission, Washington, D. C. (USA)). 1975. 77p, TIC $2.50.

Case name and legal citation indexes to issuances of the Nuclear Regulatory Commission, the Atomic Safety and Licensing Board, and the Atomic Safety and Licensing Appeal Board are presented. (JWR)

22642 ENVIRONMENTAL ASSESSMENTS: WHY, WHO, AND HOW. Parkinson, T. F. (Univ. of Missouri, Columbia). Trans. Am. Nucl. Soc.; 22: 81(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22643 METEOROLOGICAL AND CLIMATOLOGICAL CONSIDERATIONS FOR NUCLEAR POWER STATIONS. Markee, E. H. Jr. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 81-82(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22644 GEOLOGICAL CONSIDERATIONS IN THE PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS FOR NUCLEAR POWER PLANTS. Jahns, R. H. (Stanford Univ., CA). Trans. Am. Nucl. Soc.; 22: 82(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22645 PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS: RADIOLOGICAL CONSIDERATIONS. Unruh, C. M. (Battelle Northwest Labs., Richland, WA). Trans. Am. Nucl. Soc.; 22: 83(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22646 RISK-BENEFIT AND COST-BENEFIT METHODOLOGY. Eichholz, G. G. (Georgia Inst. of Tech., Atlanta). Trans. Am. Nucl. Soc.; 22: 83-84(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22647 STATE ENVIRONMENTAL IMPACT REQUIREMENTS AND POWER FACILITY LICENSING. Evans, V. A. (Commonwealth Associates, Inc., Jackson MI). Trans. Am. Nucl. Soc.; 22: 85-86(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22648 MID-CAREER TRAINING AND NUCLEAR REGULATION. Wright, R. L. Jr.; Allen, R. A. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 88-89(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22649 PROBABILISTIC RISK ASSESSMENT IN THE NUCLEAR REGULATORY PROCESS IN THE UNITED STATES: HISTORY AND PERSPECTIVE. Hanauer, S. H. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 455(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22650 STRENGTHS AND LIMITATIONS OF PROBABILISTIC RISK ASSESSMENT IN THE REGULATORY PROCESS. Gangloff, W. C. (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nucl. Soc.; 22: 455-456(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22651 CURRENT PLANS OF THE REGULATORY STAFF FOR THE USE OF PROBABILISTIC ASSESSMENT. Eisenhut, D. G.; DeYoung, R. C. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 456(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22652 PROLIFERATION OF STANDARDS. Silverwood, J. B. (United Engineers and Constructors, Inc., Philadelphia). Trans. Am. Nucl. Soc.; 22: 526(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22653 QUALITY ASSURANCE FOR ARCHITECT/ENGINEERS. McFarland, J. E. (Sargent and Lundy, Chicago). Trans. Am. Nucl. Soc.; 22: 526-527(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22654 IMPLEMENTATION OF QUALITY ASSURANCE DURING CONSTRUCTION. McMahon, V. P. (Kaiser Engineers, Oakland, CA). Trans. Am. Nucl. Soc.; 22: 527-528(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22655 CONCERNS OF INTERVENORS IN NUCLEAR POWER PLANT LICENSING HEARINGS. Shaffer, H. C. III (Ebasco Services Inc., New York); Hendricks, J.; Anoba, R.; Solan, G.; Deutsch, O.; Cook, A.; Zimmerman, W. Trans. Am. Nucl. Soc.; 22: 531(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22656 1975 NUCLEAR INDUSTRY AS A CORDUROY ROAD AHEAD. Harding, J. (Friends of the Earth, San Francisco). Trans. Am. Nucl. Soc.; 22: 531-532(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22657 CRITIC LOOKS AT THE POLITICS OF NUCLEAR POWER. Pesonen, D. E. (Californians for Nuclear Safeguards, San Francisco). Trans. Am. Nucl. Soc.; 22: 532-533(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22658 STANDARDIZATION AND THE RATCHET. Oslick, H. (Ebasco Services, Inc., New York). Trans. Am. Nucl. Soc.; 22: 549(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22659 IMPACT OF STANDARD TECHNICAL SPECIFICATIONS. Levandoski, F. J. (Babcock and Wilcox Co., Lynchburg, VA); Van Scooter, W. E.; Layer, L. L. Trans. Am. Nucl. Soc.; 22: 619(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22660 NRC STANDARD TECHNICAL SPECIFICATION PROGRAM. McGough, J. M. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 619-620(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22661 IMPLEMENTATION OF STANDARD TECHNICAL SPECIFICATIONS FROM AN NSSS VENDOR'S VIEWPOINT. Little, C. C. (Westinghouse Nuclear Center, Monroeville, PA). Trans. Am. Nucl. Soc.; 22: 620-621(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22662 ENVIRONMENTAL REGULATION OF ELECTRIC UTILITIES. Bechthold, J. L. (Northern States Power Co., Minneapolis). Trans. Am. Nucl. Soc.; 22: 627-628(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22663 REGULATORY STANDARD REVIEW PLAN. XII. Radiation Protection. Kreger, W. E. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 822(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22664 NRC REGULATORY GUIDES FOR OCCUPATIONAL RADIATION PROTECTION. Alexander, R. E. (Nuclear Regulatory Commission, Washington, DC). Trans. Am. Nucl. Soc.; 22: 822-823(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22665 CONSENSUS DEVELOPMENT IN STANDARDS FOR THE PHYSICS OF REACTOR DESIGN. Minton, G. H. (Westinghouse Electric Corp., Pittsburgh, PA). Trans. Am. Nucl. Soc.; 22: 826-827(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22666 DEVELOPMENT OF RADIATION SHIELDING STANDARDS IN THE AMERICAN NUCLEAR SOCIETY. Trubey, D. K. (Oak Ridge National Lab., TN). Trans. Am. Nucl. Soc.; 22: 828-829(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22667 PROGRESS REPORT ON THE DEVELOPMENT OF THE STANDARD ON "PROGRAM FOR TESTING RADIATION SHIELDING IN NUCLEAR REACTOR PLANTS". Persiani, P. J. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 829(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22668 STATUS REPORT ON CONCRETE SHIELDING STANDARD N403. Engholm, B. A. (General Atomic, San Diego, CA). Trans. Am. Nucl. Soc.; 22: 829-830(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22669 STATUS OF DEVELOPMENT OF STANDARD ON CALCULATION AND MEASUREMENT OF DIRECT AND SCATTERED RADIATION FROM NUCLEAR POWER PLANTS. Warman, E. A. (Stone and Webster, Boston, MA). Trans. Am. Nucl. Soc.; 22: 830(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22670 DEVELOPMENT OF A RADIATION SHIELDING STANDARD FOR IN-PLANT ZONING, PREPARED BY ANS-6.7. Biro, G. G. (Gibbs and Hill, Inc., New York). Trans. Am. Nucl. Soc.; 22: 830-831(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22671 STANDARDS: IS THERE SAFETY OR SECURITY IN NUMBERS. Straker, E. A. (Science Applications, Inc., La Jolla, CA). Trans. Am. Nucl. Soc.; 22: 831-832(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

GENERAL AND MISCELLANEOUS

Law

Refer also to abstract 20913.

22672 (NUREG–0010) STANDARD FORMAT AND CONTENT OF LICENSE APPLICATIONS FOR PLUTONIUM PROCESSING AND FUEL FABRICATION PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jan 1976. 112p. (REG/G–3.39(1-76)). NTIS $5.50.

The standard format suggested for use in applications for licenses to possess and use special nuclear materials in Pu processing and fuel fabrication plants is presented. It covers general description of the plant, summary safety assessment, site characteristics, principal design criteria, plant design, process systems, waste confinement and management, radiation protection, accident safety analysis, conduct of operations, operating controls and limits, and quality assurance. (JSR)

22673 ATOMIC ENERGY LEGISLATION THROUGH NINETY-THIRD CONGRESS, SECOND SESSION. Joint Committee on Atomic Energy, Congress of the United States, Ninety-Fourth Congress, First Session, July 1975. Washington, DC; Joint Committee on Atomic Energy (1975). 502p. GPO $4.25.

This collection of statutes and material pertaining to atomic energy legislation has been prepared for use of Joint Committee on Atomic Energy, the Congress, interested government agencies, and the public. Topics covered include: The Atomic Energy Act of 1954, as amended; Energy Reorganization Act of 1974; AEC Authorization Acts (with amendments); Euratom Cooperation Act of 1958 and Concurrent Resolution; International Atomic Energy Agency Participation Act of 1957; and Atomic Energy Community Act of 1955, as amended. (PCS)

22674 SELECTED MATERIALS ON ATOMIC ENERGY INDEMNITY AND INSURANCE LEGISLATION. Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session, March 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 574p. GPO $4.00.

In anticipation of possible modification and extension of the Price-Anderson Act beyond 1977, the Joint Committee has prepared this committee print of current studies and proposals and related comments and materials. This print should be useful for the committee and various interested groups and the public for the hearings on the Price-Anderson Act extension. (PCS)

22675 PROVIDING AN AUTHORIZATION FOR AN EX GRATIA PAYMENT TO THE PEOPLE OF BIKINI ATOLL, IN THE MARSHALL ISLANDS OF THE TRUST TERRITORY OF THE PACIFIC ISLANDS. Senate, Ninety-Fourth Congress, First Session, June 2, 1975. Washington, DC; Committee on Interior and Insular Affairs (1975). 3p. GPO.

Proposed legislation for payment of $3 million ex gratia to the people of Bikini Atoll due to their relocation resulting from nuclear-weapons testing and successive contamination of their homeland is presented. The Committee on Interior and Insular Affairs recommends passage. (PCS)

Management

22676 (AAEC/PR-42-D) NUCLEAR SCIENCE AND TECHNOLOGY BRANCH REPORT, 1975. Divisional Research. Alder, K. F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1975. 58p. Dep. NTIS (US Sales Only) $4.50.

This report describes progress in independent research work carried out on the initiative of the Division Chief or Leader of a Research Section and which he considers to be necessary for or relevant to his Division's responsibilities and capabilities. The report is administrative in nature; scientific reports on the work are given elsewhere. Subject areas included are the following: engineering research, chemical technology, instrumentation and control, materials, isotopes, physics, health physics research, applied mathematics and computing, and radiation biology research. (3 figures) (RWR)

22677 (AAEC/PR-42-N) NUCLEAR SCIENCE AND TECHNOLOGY BRANCH REPORT, 1975. Nuclear Science and Applications Program. Gregory, J. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1975. 58p. Dep. NTIS (US Sales Only) $4.50.

The nuclear science and applications program comprises the exploitation of the opportunities for "spin-off" research of advantage to Australian industry and science, investigations relating to the safety and environmental problems of nuclear activities, and development of special techniques required to support the general program of the Nuclear Science and Technology Branch. The report is administrative in nature. Besides a brief introduction, it contains the following sections: nuclear techniques of analysis, nuclear techniques in hydrology, industrial applications of radioisotopes, biological and chemical applications of irradiation, radiation detection and measurement, environmental field studies, environmental studies — laboratory and assessment work, biophysics and radiation biology, development of techniques, patents and exploitation, and staff of the nuclear science and applications secretariat. References to a number of publications on this work are included. (1 figure, 1 table) (RWR)

22678 (AAEC/PR-42-S) NUCLEAR SCIENCE AND TECHNOLOGY BRANCH REPORT, 1975. Research Establishment Site Management. Miles, G. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1975. 58p. Dep. NTIS (US Sales Only) $4.50.

This report records the technical services provided in support of the several research program at the Research Establishment. It does not record the effort expended on many major services such as administration or the routine aspects of management of the site. Many services are provided by research divisions and sections, as well as the departments directly responsible to the Site Manager. The report is administrative in nature. The following subjects are included: chemical analysis and other services, instrumentation, computing, materials, radiation standards, isotope production, γ irradiation service, HIFAR reactor, MOATA reactor, accelerator, animal house, waste management, safety, site planning, technical information services, and engineering services. (11 tables) (RWR)

22679 (CNRS-RSA-72-73) ANNUAL REPORT, OCTOBER 1972–OCTOBER 1973. (Centre National de la Recherche Scientifique, 92–Meudon-Bellevue (France)). 1973. 190p. (In French). Dep. NTIS (US Sales Only) $7.50.

Summary reports of the work done at each of the laboratories of the Bellevue Group are presented, along with a publications list. Some general remarks about staff and equipment are also made. The following groups are included: Laboratory of Dynamical Meteorology, Laboratory of Geology of the Quaternary, Laboratory of the Physics of Materials, Laboratory of Aerothermics, Laboratory of Molecular Interactions and High Pressures, Laboratory of Magnetism, Laboratory of the Physics of Solids, Group for the Study and Synthesis of Microstructures, Electrolysis Laboratory, Laboratory of the Chemistry of Macromolecules under Irradiation, Laboratory of Rare Earths, Center for Research on Nutrition, Laboratory of the Physiology of Plant Organs after Harvesting, Prototype Construction Group, and Group for the Research of the Mechanics of Surfaces. Each of these groups prepares its own annual report. The publications list runs to 84 pages. (RWR)

22680 (ERDA-100) REPORT OF THE FIELD AND LABORATORY UTILIZATION STUDY GROUP. (Energy Research and Development Administration, Washington, D. C. (USA)). Dec 1975. 59p. Dep. NTIS $4.50.

The Field Laboratory Utilization Study Group of ERDA concentrated on organizational and management improvements that might contribute to the optimum utilization of existing field and laboratory resources in accomplishing the mission of ERDA. Emphasis was on provisions affecting the management decision-making process. After an executive summary and introduction, the group's findings are presented in chapters entitled organization and management practices, planning and control, technology transfer/commercialization, and performance/quality. Recommendations are presented in two parts, on organization and management and planning/control. 8 figures (RWR)

22681 (ERDA-100(App.)) REPORT OF THE FIELD AND LABORATORY UTILIZATION STUDY GROUP. Appendix. (Energy Research and Development Administration, Washington, D. C. (USA)). Dec 1975. 170p. Dep. NTIS $6.75.

These appendices (ERDA organization and management, summary of other resources, and FLU study considerations/inputs) provide detailed and quantitative information in support of the findings and recommendations presented in the report of the field and laboratory utilization study group. (RWR)

22682 (ERDA-116(Vol.1)) BALANCED PROGRAM PLAN: ANALYSIS FOR BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Volume 1. Overview and Summary. (MITRE Corp., McLean, Va.

(USA)). Oct 1975. Contract E(49-1)-3764. 200p. Dep. NTIS $8.50.

An analysis of requirements has been performed for ERDA's Division of Biomedical and Environmental Research to identify the key environmental problems associatcd with the development of nine energy technology alternatives and to define the necessary health and environment research activities. In this document, an overview of the technologies is given, with a summary of key environmental problems and research needs. The interrelationships of the research activities are defined, and a preliminary allocation, based on resource estimates derived from the identified research needs, is given. The nine technologies considered include: coal extraction, processing, and combustion; coal conversion processes; liquid fuel from oil shales; the development of procedures and devices to effect energy conservation and improve the efficiency of energy systems; the conversion of solar energy into usable forms of energy; geothermal energy systems; nuclear fusion power from controlled thermonuclear reactors; and commercial electric power generation based on nuclear fission. (CH)

22683 (NP-20770) ANNUAL REPORT, 1974–1975. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1975. 83p. (In English and French). Atomic Energy Control Board, Ottawa, Canada.

The Annual Report of the Atomic Energy Control Board for the period ending March 31, 1975, as presented to the Minister of Energy, Mines and Resources, contains the following sections: introduction, legislation and regulations, organization, modus operandi, nuclear reactors, heavy-water plants, particle accelerators, radioisotopes, fissionable substances, radioactive waste management, transportation of radioactive materials, safeguards, security, research grants and agreements, financial statement, and acknowledgments. There are also fourteen appendices, mostly concerned with personnel. The report is descriptive in nature. (RWR)

22684 SURVEY OF WOMEN IN NUCLEAR ENGINEERING. Marcus, G. H. (Analytic Services, Inc., Falls Church, VA). Trans. Am. Nucl. Soc.; 22: 76(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22685 WOMEN AND AFFIRMATIVE ACTION IN THE NUCLEAR FIELD. Bowden, M. A. (Energy Research and Development Administration, Washington, DC). Trans. Am. Nucl. Soc.; 22: 76-77(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22686 WOMEN IN ENGINEERING EDUCATION. Abron-Robinson, L. A. (Howard Univ., Washington, DC). Trans. Am. Nucl. Soc.; 22: 77-78(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22687 WOMEN IN INDUSTRY: RADIATION EXPOSURE LEVEL STANDARDS. Bond, V. P. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 78-79(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22688 HIGH-ACHIEVING WOMAN AND THE ARCHITECTURE OF IDENTITY. Stark, N. N. (Univ. of California, Los Angeles). Trans. Am. Nucl. Soc.; 22: 79(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22689 SOME COMMANDMENTS FOR WOMEN IN MANAGEMENT. Harness, A. (Hanford Engineering Development Lab., Richland, WA). Trans. Am. Nucl. Soc.; 22: 79-80(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

Mathematics and Computers

Refer also to abstracts 19867, 20315, 20316, 20407, 20409–20414, 20898, 21562, and 22676.

22690 (ANL-8040(Suppl.3)) USERDA COMPUTER PROGRAM SUMMARIES. Numbers 177-239. (Argonne National Lab., Ill. (USA)). Oct 1975. Contract W-31-109-Eng-38. 70p. Dep. NTIS $5.00.

Since 1960 the Argonne Code Center has served as a U. S. Atomic Energy Commission information center for computer programs developed and used primarily for the solution of problems in nuclear physics, reactor design, reactor engineering and operation. The Center, through a network of registered installations, collects, validates, maintains, and distributes a library of these computer programs and publishes a compilation of abstracts describing them. In 1972 the scope of the Center's activities was officially expanded to include computer programs developed in all of the U. S. Atomic Energy Commission program areas and the compilation and publication of this report. The Computer Program Summary report contains summaries of computer programs at the specification stage, under development, being checked out, in use, or available at ERDA offices, laboratories, and contractor installations. Programs are divided into the following categories: cross section and resonance integral calculations; spectrum calculations, generation of group constants, lattice and cell problems; static design studies; depletion, fuel management, cost analysis, and reactor economics; space-independent kinetics; space–time kinetics, coupled neutronics–hydrodynamics–thermodynamics and excursion simulations; radiological safety, hazard and accident analysis; heat transfer and fluid flow; deformation and stress distribution computations, structural analysis and engineering design studies; gamma heating and shield design programs; reactor systems analysis; data preparation; data management; subsidiary calculations; experimental data processing; general mathematical and computing system routines; materials; environmental and earth sciences; space sciences; electronics and engineering equipment; chemistry; particle accelerators and high-voltage machines; physics; controlled thermonuclear research; biology and medicine; and data. (RWR)

22691 (HMI-B-183) CONCEPT OF A BASIC SOFTWARE SYSTEM FOR A PLASMA PANEL DISPLAY. Tschammer, V. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Datenverarbeitung und Elektronik). Oct 1975. 18p. (In German). Dep. NTIS (US Sales Only) $4.00.

The paper describes the concept of a basic software system for running a Plasma-Panel Display on an on-line computer. This software system should solve all display-hardware-related problems and additionally provide the user with a number of powerful and flexible subroutines which will enable him to carry out all his graphic tasks effectively. (auth)

22692 (ORO-3443-58) HOMOGENIZATION APPROACH IN ENGINEERING. Babuska, I. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Oct 1975. 21p. (TN-BN-828). Dep. NTIS $3.50.

Homogenization is an approach which studies the macrobehavior of a medium by its microproperties. Problems with a microstructure play an essential role in such fields as mechanics, chemistry, physics, and reactor engineering. Attention is concentrated on a simple specific model problem to illustrate results and problems typical of the homogenization approach. Only the diffusion problem is treated here, but some statements are made about the elasticity of composite materials. The differential equation is solved for linear cases with and without boundaries and for the nonlinear case. 3 figures, 1 table. (RWR)

22693 (UCRL-50025-75-3) ELECTRONICS ENGINEERING DEPARTMENT QUARTERLY REPORT NO. 3, 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jul 1975. Contract W-7405-Eng-48. 32p. Dep. NTIS $4.00.

Several projects of the EE department at Lawrence Livermore Laboratory are briefly described. The following items are discussed: a modular microcomputer system, a control system for automated chemical analyses for use in fast rabbit/rapid chemistry, microcomputers for logging of effluent characteristics, an automated message processing system, microcomputers for controlling fast-transient oscilloscopes, a programmable machine-control system, microcomputers for wind calculations, and the use of microcomputers for computation. A microcomputer technology-transfer program with nearby community colleges is also described. 27 figures, 1 table (RWR)

22694 RANDOM NUMBER SET FOR MONTE CARLO COMPUTATIONS. Frigerio, N. A.; Clark, N. A. (Argonne National Lab., IL). Trans. Am. Nucl. Soc.; 22: 283-284(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, Ca, USA (16 Nov 1975).

22695 SOLUTION OF THE HEAT DIFFUSION EQUATION BY A FORWARD MONTE CARLO METHOD. Troubetzkoy, E. S. (Mathematical Applications Group, Inc., Elmsford, NY) Banks, N. E. Trans. Am. Nucl. Soc.; 22: 284-285(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

22696 ADJOINT MONTE CARLO METHOD FOR THE RELIABILITY ANALYSIS OF A MARKOV SYSTEM. Buslik, A. J. (Brookhaven National Lab., Upton, NY). Trans. Am. Nucl. Soc.; 22: 285-286(Nov 1975).

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